KHUTZEYMATEEN VALLEY GRIZZLY BEAR STUDY

Annual Progress Report - Year 2 (1990/91)

Annual Working Plan - Year 3 (1991/92)

Ministry of Environment,
Lands and Parks

Wildlife Working Report No. WR-51
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March 1992

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A Cooperative Project Between the
Ministries of Forests and Environment, Lands and Parks

Wildlife Branch
BC Environment
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Research Branch
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1.0 BACKGROUND

The Khutzeymateen Valley Grizzly Bear Study is a component of the Khutzeymateen Project, a 3-year cooperative study designed to provide information necessary to develop a plan for future use of the Khutzeymateen watershed in north coastal British Columbia. An initial working plan was developed (Hamilton and Nagy 1990) and the first two seasons of field study were completed in 1989 and 1990. The results of the 1989 field season and working plan for year 2 are presented in Nagy and MacHutchon (1991). This report summarizes progress in the second year (1990) and presents a working plan for year 3 - 1991/92.

2.0 OBJECTIVES

The objectives of the Khutzeymateen Valley Grizzly Bear Study are:

1) to test current concepts of seasonal habitat use and selection by coastal grizzly bears and, if necessary, to develop a revised conceptual model applicable to the Khutzeymateen ecosystem;

2) to identify, map, and determine the availability of habitat units and assess their relative importance to grizzly bears using the Khutzeymateen;

3) to identify and quantify the available resources (e.g., food, cover) within these habitat units and assess their relative importance to grizzly bears using the Khutzeymateen;

4) to estimate the population density of grizzly bears resident in the Khutzeymateen, and estimate the total number of bears using the watershed; and

5) to predict and assess the impacts of proposed land-use scenarios for the Khutzeymateen on grizzly bears and their habitat.

Data collection during the 1990 field season focused primarily on objectives 2, 3, and 4.

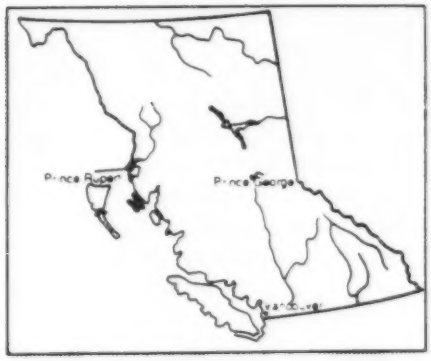
3.0 STUDY AREA

The study area includes the drainages of the Khutzeymateen River and Larch and Cedar creeks and is approximately 443 km^2 in size (Fig. 1). The majority of intensive field research on grizzly bears was carried out in the Khutzeymateen watershed portion of the study area. The study area is located 45 km northeast of Prince Rupert at the head of Khutzeymateen Inlet.

The climate is wet, humid, mild, and oceanic (Banner and Yole 1986). As elevation increases, temperatures decrease and total precipitation and snowfall increase. Information summarized for five weather stations indicates that temperatures vary little throughout the year: the mean annual temperature is 7°C, the mean temperature of the warmest month is 16.1°C, and the mean of the coldest month is -3.1°. Precipitation is heavy: mean annual precipitation is 304 cm and mean annual snowfall is 356 cm (approximately 12% of the annual precipitation). Although winter conditions are not usually extreme, outflow winds can lead to freezing of Khutzeymateen Inlet.

The Khutzeymateen study area is located in the Western Kitimat Ranges of the Coast Mountains. Topography is rugged with elevations ranging from sea level to over 2100 m. Several active glaciers occur in the drainage. The terrain in the watershed has been mapped at 1:50 000 (Baender 1976). Major terrain units include: a large, active estuary, level fluvial areas (floodplain), some upslope units that are extremely shallow to bedrock, numerous avalanche chutes, organic bogs, and several colluvial and alluvial fans. Soils are typically Humo-Ferric Podzols and Ferro-Humic Podzols in mid-slope positions, however Typic Folisols are common on shallow-to-bedrock sites.

Three biogeoclimatic zones are represented in the watershed: the Coastal Western Hemlock (CWH) Zone (CWHvm and CWHwm Subzones), the Mountain Hemlock (MH) Zone (MHmf and MHp Subzones), and the Alpine Tundra (AT) Zone. The Very Wet Maritime (CWHvm) Subzone was formerly called the CWHi Subzone. Draft ecosystem classifications for the CWHi are available (e.g., Yole et al. 1982, Banner and Yole 1986). The zonal plant association (Pojar et al. 1987) is *Tsuga heterophylla* (western hemlock) - *Abies amabilis* (amabilis fir) - *Thuja plicata* (western redcedar) - *Vaccinium* spp. (blueberry, huckleberry species) - *Blechnum spicant* (deer fern) - *Rhytidiadelphus loreus* (lanky moss) - *Hylocomium splendens* (step moss). Seral associations on the Khutzeymateen floodplain appear typical of those further south with *Alnus rubra* (red alder) and *Populus balsamifera* ssp. *trichocarpa* (black cottonwood)



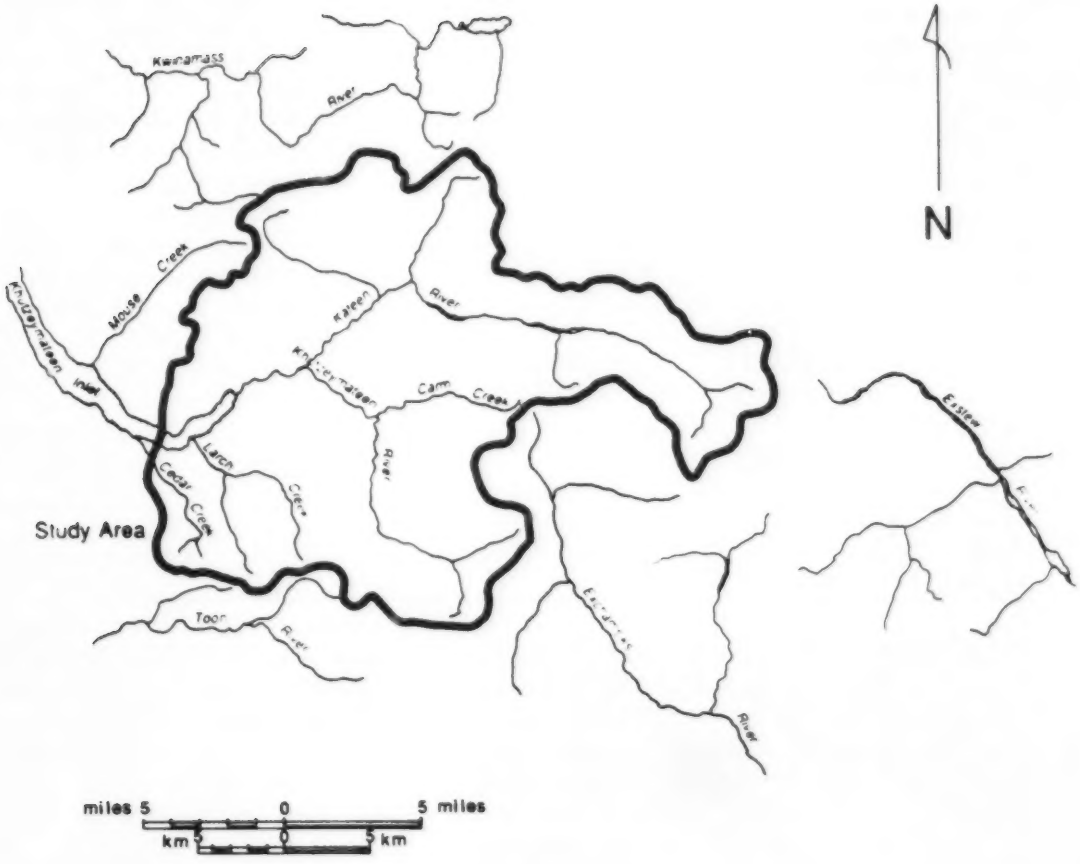


Figure 1. Boundaries of the Khutzeymateen Valley grizzly bear study area.

dominating (Banner 1985). Some sampling of logged sites has been completed in the Khutzeymateen Inlet as part of an investigation of the effects of porcupines (*Erethizon dorsatum*) on forest regeneration (Sullivan et al. 1986).

The fisheries resource of the Khutzeymateen has been estimated to have a commercial value as high as $5 million annually (Jantz 1984). Net wholesale contribution to the economy is $1.58 million per annum (Kremer 1985). For the years 1980-88, Khutzeymateen River escapements averaged 385 chinook, 4080 coho, 7610 chum, and 46 400 pink (Jantz et al. 1988). A few steelhead also spawn in the Khutzeymateen River. Chinook generally arrive in late July, start spawning in mid-August, and end by mid-September. Coho arrive in late August, begin spawning in late October, and end by early-December. There are generally two runs of chum salmon. The first run arrives in mid-July, starts spawning in late July, and ends by mid-August. The second run of chum arrives in mid-August, starts spawning in late August, and ends in late September. Pink salmon arrive in mid-July, start spawning in early-August, and ends by mid-September (*ibid.*). In 1986, a salmon habitat inventory project was undertaken by the Department of Fisheries and Oceans (Karanka 1986). Additional fish habitat inventory and stream classification was completed in 1990.

In addition to grizzly bears, many other wildlife species occur in the Khutzeymateen study area, including Bald Eagles (*Haliaeetus leucocephalus*), black bears (*Ursus americanus*), wolves (*Canis lupus*), river otters (*Lutra canadensis*), porcupines, mountain goats (*Oreamnos americanus*), and harbour seals (*Phoca vitulina*). The large estuary is an important staging area for migratory waterfowl.

There are three small Indian reserves (IR 38, 39, and 49) in the Khutzeymateen. Heritage resources of the watershed were examined during 1989 by the Archaeology and Outdoor Recreation Branch, Ministry of Municipal Affairs, Recreation, and Culture, in cooperation with the Port Simpson Indian Band (Eldridge 1989, Eldridge et al. 1990). Historic structures were located on the north shore of the inlet near the Khutzeymateen estuary and IR 49 along the lower Khutzeymateen River. Both sites were thought to be fishing camps (Eldridge et al. 1990).

The only significant logging in the Khutzeymateen watershed occurred in 1950, when a small stand of timber adjacent to the estuary was removed by Columbia Cellulose Ltd. (Karanka 1986), and in 1956 when IR 49 was logged (Eldridge et al. 1990). Considerable volumes have been removed from Khutzeymateen Inlet by "A-frame" operators in the 1950's and 1960's (Sullivan et al. 1986), and by helicopter in the early 1980's under a major Timber Sale Licence to Silver Grizzly Ltd.

4.0 PROGRESS MADE DURING 1990-91

4.1 Field Activities

Field work in 1990 was conducted from April 15 to October 31. Activities from April 15 to May 21 included camp set up and organization of field equipment; weekly aerial telemetry surveys for two adult females (GF18 and GF34) and daily ground telemetry locations of an adult female (GF34); site investigations along Khutzeymateen Inlet, estuary and lower river; establishment of 9 permanent plots to monitor the phenology of major grizzly bear food species; transport of equipment, fuel and bait from Prince Rupert; and reconstruction of trapsites on or near the estuary. Trapping was conducted from May 22 to June 5. During the same period, 2 den sites of radio-collared bears were visited and 4 collars, dropped by grizzly bears in 1989, were retrieved. The main field activities from June 7 to October 31 were: ground telemetry locations of radio-collared bears, weekly aerial telemetry surveys, ground investigations of telemetry locations, reconnaissance of rarely visited areas, establishment of fixed ground telemetry stations, weekly visits to permanent plant phenology plots, trail cutting in the Carm Creek area, liaison with groups visiting the valley, maintenance of daily activity records and observations, and maintenance and repair of field equipment.

Trapping

Grizzly bears were captured, immobilized, and handled using previously described procedures (Hamilton and Nagy 1990). Helicopter-monitored trapping activities were conducted from May 22 to June 5. Traps were established at 18 sites located on the estuaries of the Khutzeymateen River and Cedar and

Larch creeks, and along the Khutzeymateen River, Kateen River, and Carm Creek. A total of 338 trap-nights resulted in 17 captures (13 grizzly bears and 4 black bears)(Table 1). Capture rate was 1 bear per 20 trap-nights, 1 grizzly bear per 26 trap-nights and 1 black bear per 85 trap-nights. Ten different grizzly (6 males and 4 females, 7 new in 1990 and 3 from 1989) and 4 different black bears were captured (4 male, all new in 1990).

4.2 Population Characteristics

4.2.1 Methods – As in 1989 (Nagy and MacHutchon 1991), two methods were used to identify grizzly bears using the Khutzeymateen valley: trapping and incidental observations of distinct individuals. In addition, two helicopter surveys were conducted during the trapping period to search for grizzly bears or their sign over most of the study area.

Sightings made by other people in the watershed were recorded in addition to observations by study personnel. All observations were plotted on air photos and the date, time, number of bears, activity, elevation and habitat type were recorded. Each bear was described using standardized colour phase/pattern codes and sex and age class were recorded when possible (*ibid*).

Data obtained from trapping, aerial telemetry flights, aerial surveys during the trapping period, and incidental observations were used to derive a minimum estimate of the number of individual grizzly bears that use the Khutzeymateen watershed on a seasonal and annual basis. Many of the grizzly bears identified in 1989 did not have visual markers, so they were not discernable, with any confidence, from bears identified in 1990. Therefore, grizzly bears identified in 1990 were matched to probable individuals from 1989, before any new grizzly bears were added to the total. Sightings and telemetry information were also used to derive minimum estimates of grizzly bears using specific smaller areas, including the Khutzeymateen estuary in the spring, the lower Khutzeymateen and lower Kateen during salmon spawning, and lower Carm Creek during salmon spawning.

4.2.2 Results and Discussion. —

Grizzly bear observations

Incidental observations of unmarked grizzly bears were made 377 times during the field season. This included multiple sightings of the same bears, females with cubs-of-the-year (COY), yearlings, or subadults, mated pairs, and subadult groups. There were 88 incidental observations of radio-collared bears. In

Table 1. Capture success in the Khutzeymateen watershed and Larch and Cedar drainages during the trapping period May 23 to June 4, 1990 . A total of 10 individual grizzly and 4 individual black bears were captured.

			Captures								
			Grizzly		Black		Total		Trapnights per Capture		
Date	Trap-Nights	Trap Nights	Total Day Total	Total	Day Total	Total	Day Total	Total	Grizzly	Black	Total
23	8	8	0	0	1	1	1	1	—	8	8
24	11	19	0	0	0	1	0	1	—	19	19
25	18	37	1	1	0	1	1	2	37	37	19
26	21	58	1	2	1	2	2	4	29	29	15
27	18	76	1	3	0	2	1	5	25	38	15
28	26	102	0	3	1	3	1	6	34	34	17
29	31	133	0	3	0	3	0	6	44	44	22
30	44	177	1	4	0	3	1	7	44	59	25
31	40	217	3	7	0	3	3	10	31	72	22
1	36	253	2	9	0	3	2	12	28	84	21
2	24	277	0	9	0	3	0	12	31	92	23
3	31	308	0	9	1	4	1	13	34	77	24
4	30	338	4	13	0	4	4	17	26	85	20

addition to incidental observations, radio-collared bears were observed on 100 occasions during aerial or ground telemetry. Grizzly bears were observed throughout the study area, but most often on estuaries, along riverbanks or along the Carm Creek trail.

Population estimate

A minimum of 43 different grizzly bears (all age classes) used the Khutzeymateen study area during at least one season in 1990 (Table 2). This is 7 more grizzly bears than was estimated for 1989 (Nagy and MacHutchon 1991). Seven grizzly bears (4 males, 3 females) were new captures in 1990. Two of the 4 newly captured males and 2 of the 3 newly captured females were considered to be different individuals than those identified in 1989. Two females identified or marked in 1989 had a total of 5 COY accompanying them in 1990. One of the newly captured female grizzly bears was accompanied by 2 yearlings. Four mortalities were known or suspected to have occurred among the 36 bears identified in 1989 (see Mortality section). All other grizzly bears identified in 1989 were assumed to have survived into 1990 and used the Khutzeymateen watershed. It is possible that this assumption was violated by additional mortality and permanent dispersal of subadult bears, however, the estimate was still a minimum because of a conservative approach to identifying bears as different individuals or family groups.

Table 2. The minimum number of grizzly bears estimated to have used the Khutzeymateen study area during 1989 and 1990.

Class	Number
Lone males	13
Lone females	4
Females with COY[a]	2
COY	5
Females with yearlings	3
Yearlings	7
Females with 2 year olds	3
2 year olds	6
TOTAL	43

[a]COY = Cub of the year

Not all grizzly bears identified as using the Khutzeymateen watershed in 1990 were resident throughout the year. A male grizzly bear radio collared in spring 1990 (GM45), left the valley shortly after capture and was not located again. A female radio collared on the Khutzeymateen estuary in fall 1989 (GF34), denned in Mouse Creek and was active around the Mouse Creek estuary in spring, 1990 before she was killed. Another female radio collared on the Khutzeymateen estuary in 1990 (GF41), spent from mid-June to mid-August in lower Mouse Creek and along Khutzeymateen Inlet before returning to the Khutzeymateen valley. Three radio-collared females moved back and forth between Carm Creek and the Exchamsiks River during late June and early August (see also Nagy and MacHutchon 1991). A population density estimate for the Khutzeymateen valley will be determined after the third year of data collection.

Seasonally Concentrated Use

It was not possible to exactly identify unmarked individuals or family groups over the long term, however, it was possible over short periods of time when researchers or others were frequently seeing the same bears. This short term assessment of use was conducted in three areas of the watershed, the Khutzeymateen estuary in the spring, lower Carm Creek during salmon spawning, and the lower Khutzeymateen and Kateen Rivers during salmon spawning. Despite the frequent visibility of grizzly bears in these areas, estimates of seasonal use were minimums because of a conservative approach to identifying individuals and because not all bears were seen regularly.

A minimum of 19 different grizzly bears used the Khutzeymateen estuary during the spring, including 2 subadult males, 1 subadult female, 2 subadults (unknown sex), 2 adult males, 3 adult females with a total of 5 yearlings, and 1 adult female with 3 COY (this study, McCrory pers. comm., Russell pers. comm.)

A minimum of 9 different grizzly bears used lower Carm Creek during the salmon spawning period, including 3 lone adult females, 2 adult females with a total of 3 yearlings and one individual of unknown sex and age.

A minimum of 24 different grizzly bears used the lower Khutzeymateen and Kateen rivers during the salmon spawning period, including 3 subadult males, 1 subadult female, 1 subadult (sex unknown), 1 adult male, 2 lone adult females, 1 female with 2, 2-year-olds, 3 females with a total of 6 yearlings, and 1 adult female with 3 COY (*ibid.*).

Some grizzly bears likely did not restrict their activity to only one or the other of the salmon spawning areas identified above. At least one family group was believed to have moved between the two areas. All of the radio-collared bears were active in one or the other salmon spawning areas identified above.

Physical characteristics

The physical measurements of all grizzly and black bears captured in 1990 are summarized in Appendix 1.

Reproductive characteristics

Female GF18 (age 14 years in 1990), believed to have bred with male GM04 in 1989, produced 2 COY in 1990. A female observed with males GM04 and GM08 in 1989, produced 3 COY in 1990. Female GF26 (age 14 years in 1990) was accompanied by 3, 4-year-old young when captured in 1989. The family broke up in early June, and GF26 was believed to have then bred with male GM32. However, she was alone in 1990. Female GF40 (age 17 years in 1990) is believed to have weaned one young in the spring of 1990 prior to her capture, however, it is unknown whether she bred in 1990. Female GF41 (age 15 years in 1990) was accompanied by 2 yearlings and female GF43 (age 24 years in 1990) was alone when captured in 1990. The mean litter size for family groups identified in the Khutzeymateen watershed during 1989 and 1990 was 2.4 COY/litter (n = 5) and 1.8 yearlings/litter (n = 5).

Mortality

Female GF41 was accompanied by 2 yearlings when first captured on the Khutzeymateen estuary in 1990. It was believed that she was accompanied by 3 COY in 1989. The remains of a yearling grizzly bear were found on the north side of the Khutzeymateen estuary in mid-June 1990 near her area of spring activity. It was possible the dead bear was one of her young. Cause of death was not evident.

In 1989, an unmarked female grizzly bear was observed in the area of the Carm Creek and Khutzeymateen River junction and was accompanied by 3 COY; one cub had a large white "V" on its chest. In 1990, an unmarked female grizzly bear was observed in the same area on two occasions, accompanied by two yearlings, one with a large white "V" on its chest. It was probable that they were the same family group and that one of the cubs died between 1989 and 1990.

Female GF34 was accompanied by 3 COY when she was first captured in fall 1989. In spring 1990, she was only accompanied by 2 yearlings. During a subsequent investigation of her den site the remains of the third cub were found. Cause of death was not evident.

Female GF34 and her 2 yearlings were active near the estuary of Mouse Creek throughout early spring, 1990. All three bears appeared healthy with no signs of injury. They were regularly observed feeding undisturbed until May 20, at which time GF34 seemed agitated by something in the trees behind her (McCrory pers. comm.). Eventually, the family ran off, but the source of their concern was not observed. The next day, however, a large lone grizzly bear, likely an adult male, was observed on the Mouse Creek estuary. This bear was observed on the Mouse Creek estuary periodically during the next 10 days. Telemetry locations of GF34 suggested she did not venture close to the estuary during this period. She was active on slopes to the north of Mouse Creek or along Khutzeymateen Inlet northeast of Mouse Creek through the rest of May and early June. On June 13, GF34 and her 2 yearlings were observed feeding along the shore of Khutzeymateen Inlet, just northeast of Mouse Creek, at which time GF34 was limping badly on her right rear leg. The cause of the limping was not evident. On June 17, GF34 was aerially located near the mouth of Mouse Creek. The activity sensor on her radio-collar indicated she was immobile. Two subsequent aerial surveys indicated she was in the same general area. The site was visited on June 28 and her body found.

At the time of discovery, GF34's carcass was in a well excavated bed site. Her skin was turned inside out and all the muscle had been eaten or decomposed. Her entrails were buried in the duff. Both her tibia were broken, the right in three places, however, there was no bruising on the bone. There was considerable hemorrhaging under the skin on the outside of the right rear leg and the inside of the right rear thigh near the

vulva and anus. The entire right side of the skull below the sagittal crest was crushed and the zygomatic arch broken. There were 2 puncture wounds on the outside right leg associated with the area of hemorrhaging and 2 further down the leg, as well as 2 on the right side of the head below the ear, 2 on the right side of the head at the jaw articulation, 1 inside the right ear, and 2 on the lower jaw below the lower incisors. The punctures appeared to be canine wounds, however, the paired wounds were only 4 cm apart; the approximate canine span of a yearling grizzly bear. The available evidence suggested GF34 was killed by another grizzly bear, but it was unclear whether the same bear fed on her. GF34's yearlings or their sign were not observed again in 1990.

4.3 Seasonal Food Habits

4.3.1 Methods. — The food items used by grizzly bears in the Khutzeymateen watershed were determined by evaluating feeding activity during site investigations, scat analysis in the field, and incidental observations of feeding behaviour. Before the salmon spawning period, known-aged scats were collected opportunistically and frozen. During the salmon spawning period scat contents were noted in situ. Approximately 250 scats were collected and frozen for subsequent analyses in 1990. Sixty five scats from the 1990 collection have been analyzed to date, but the results will not be included in this report.

Grizzly bear seasons of activity for the Khutzeymateen watershed were defined by general shifts in the use of major food items. These shifts were determined by graphing the percent frequency of occurrence of food items at feeding sites by week (using a Julian week to ensure consistency between years). For 1990, food item records from site investigations were used in the determination of activity seasons. For 1989, site investigations, field evaluation of scats, and incidental observations of feeding activity were used.

4.3.2 Results and Discussion. —

Diet

In 1990, 3 food items were added to the 1989 list of 39 known grizzly bear foods in the Khutzeymateen study area (Nagy and MacHutchon 1991)(Table 3). Pacific crabapple (*Malus fusca*) berries were eaten in the late summer and fall, Touch-me-not (*Impatiens nolitangere*) shoots were eaten in the early to mid summer, and 1 instance of feeding on black bear was recorded. For some previously known plant foods, additional parts of the plant were found to be used (Table 3).

A grizzly bear was observed digging for clams in 1990, which corroborates the finding of 1989 (*ibid.*). Several grizzly bears were observed eating barnacles in the intertidal zone at low tide and scats containing barnacles were found at grizzly bear activity sites.

Table 3 lists all known grizzly bear food items on the study area and the parts that were consumed. Sedges (*Carex* spp. and *Scirpus* spp.) were the most frequently eaten food item from late April until early July. Skunk cabbage (*Lysichiton americanum*) were eaten throughout the active period, but were most common in the diet during late June and July and again in late September and October. Several Umbelliferae [cow-parsnip (*Heracleum sphondylium*), beach lovage (*Ligusticum scoticum*), angelica (*Angelica* spp), Pacific hemlock parsley (*Conioselinum pacificum*), and water-parsley (*Oenanthe sarmentosa*)] were common in the diet during mid to late June and July and again in late September and early October.

All berry species in the Khutzeymateen were eaten by grizzly bears in varying amounts, apparently depending on local and annual abundance as well as relative availability. The frequency and timing of use of different berries corresponded to the dates of ripening. The chronological order of use was salmonberry (*Rubus spectabilis*), blueberry and huckleberry, red elderberry (*Sambucus racemosa*), stink currant (*Ribes bracteosum*), devil's club (*Oplopanax horridus*), highbush cranberry (*Viburnum edule*), red-osier dogwood (*Cornus sericea*), and Pacific crab apple. Berries were primarily eaten between early July and early September.

Major runs of salmon began moving into the Khutzeymateen River in late July and early August and became the major food item of grizzly bears until mid to late October. Bears fed on freshly killed spawning salmon as well as the carcasses of spawned out salmon.

Seasons of Activity

Three general seasons of activity were defined for grizzly bears using the Khutzeymateen watershed. The beginning of season 1 and season 2 were later in

Table 3. Food items known to be consumed by grizzly bears in the Khutzeymateen watershed.

Food Item	Portion Consumed
Angelica genuflexa	roots, corms, stems
Athyrium filix-femina	young fronds
Barnacles	entire
Carex lyngbei	leaves
Carex sitchensis	tips of leaf blades
Carex spp.	tips of leaf blades
Cicuta douglasii	roots, flower heads, stems
Clams	entire
Conioselinum chinense	flower heads, stems, roots
Cornus sericea	berries
Deschampsia caespitosum	tips of leaf blades
Dryopteris assimilis	young fronds
Equisetum spp.	leaves
Graminae spp.	tips of leaf blades
Heracleum sphondylium	roots, flower heads, stems
Impatiens noli-tangere	stems, leaves
Insects	larva, adults
Juncus spp.	tips of leaf blades
Ligusticum scoticum	roots
Lonicera involucrata	berries
Lupinus nootkatensis	roots
Lysichiton americanum	underground portion of petioles
Mammal	carcasses, fresh kills
Malus fusca	berries
Monita spp.	roots, corms
Oenanthe sarmentosa	flower heads, stems
Oplopanax horridus	leaf buds and petioles, berries
Osmorhiza chilensis	roots, corms, stems
Osmorhiza spp.	roots, corms, stems
Ribes bracteosum	berries
Rubus spectabilis	stems, berries
Rubus ideaus	berries
Salmon-decomposed	not gill rakers and sperm sacks
Salmon-fresh	not gill rakers and sperm sacks
Sambucus racemosa	stems, berries
Scirpus microcarpus	leaves
Stachys mexicana	leaves, stems
Streptopus roseus	berries
Vaccinium alaskense	berries
Vaccinium ovalifolium	berries
Veratrum viride	emerging leaf buds, berries
Viburnum edule	berries

1989 than 1990 (July 18 vs July 4 for season 1 and August 22 vs August 15 for season 2) (Figures 2 & 3).

1. **Greens** - Season 1 lasted from den emergence until berries were the major food item in the diet. During this period grizzly bears ate a variety of herbaceous plants. The feeding pattern varied between species and phenological state of the plant. In 1989, season 1 was considered as den emergence until the end of week 28 (July 18) (Fig. 2). In 1990, season 1 was considered as den emergence until the end of week 26 (July 4) (Fig. 3).

2. **Berries** - Season 2 lasted from the end of season 1 (greens) until salmon became the major grizzly bear food item. During this season, bears also ate a variety of different berries as well as several different forbs. In 1989, season 2 was considered as the beginning of week 29 to the end of week 33 (July 19 to August 22) (Fig. 2). In 1990, season 2 was considered as the beginning of week 27 to the end of week 32 (July 5 to August 15) (Fig. 3).

3. **Salmon** - Season 3 lasted from the end of season 2 until grizzly bears entered their winter dens. During this season grizzly bears primarily fed on spawning salmon or spawned out salmon carcasses. In the late fall when salmon carcasses became scarce, bears also fed on a variety of forbs. In 1989, season 3 was considered as the beginning of week 34 to den entrance (August 23 to late October or early November) (Fig. 2). In 1990, season 3 was considered as the beginning of week 33 to den entrance (August 16 to late October or early November) (Fig. 3).

4.4 Home Ranges and Movements

4.4.1 Methods. — Male and female grizzly bears were fitted with fixed-diameter radio collars using the methods described in Nagy and MacHutchon (1991).

Aerial telemetry surveys began on April 10 and were conducted weekly until October 31 using the methods described in Nagy and MacHutchon (1991). All locations were plotted on 1:14000 colour air photos and transferred to 1:10000 habitat/ TRIM (Terrain Resource Inventory Mapping) maps. Ground telemetry locations of radio-collared grizzly bears began on April 24 and continued until October 18. Ground monitoring was conducted using a similar system as described by Nagy and MacHutchon (1991). Permanent radio telemetry stations were established at intervals of 100 - 150 m along the Khutzeymateen River, Kateen River, Carm Creek and Khutzeymateen Inlet. Approximately 75 ground telemetry stations were established or reestablished and approximately 4 km of trail were cut to access Carm Creek. At each station, a 1.5 m length of 2.5 cm diameter conduit pipe was driven vertically into the ground or log. A mobile telemetry pole, consisting of a 4-element antenna attached horizontally to the end of a 2.0 m aluminum pole could be inserted into the conduit pipe. The antenna could be freely rotated 360°. A compass, fit into the handle of the aluminum pole, was used to take bearings. If a bear was beyond the range of the fixed telemetry stations then a hand-held "H" antenna was used to obtain bearings from remote points.

Bearings were taken from at least three different points to determine a radio-collared grizzly bear's location. Bearings were plotted on air photos to indicate the approximate position of the bear for subsequent ground investigation. If the location was not visited on the ground then the bearings were entered into a portable computer and the best estimate of the bear's location in UTM coordinates was determined using the program POLYGON (Page 1982).

Aerial and ground telemetry location data and incidental sightings were used to determine home range size. The combined sample of locations from aerial, ground and incidental sightings were a discontinuous sample of points across time for most grizzly bears. To minimize concerns about the lack of independence of locations only 100% minimum polygon (MCP) estimates of home range size were determined. Home range size was determined using program HOME RANGE (Ackerman et al. 1989).

4.4.2 Results and Discussion. — Eight grizzly bears were fitted with radio collars in 1990; 4 adult females (3 new, 1 recollared from 1989), 2 adult males (both new), and 2 subadult males (both recaptures

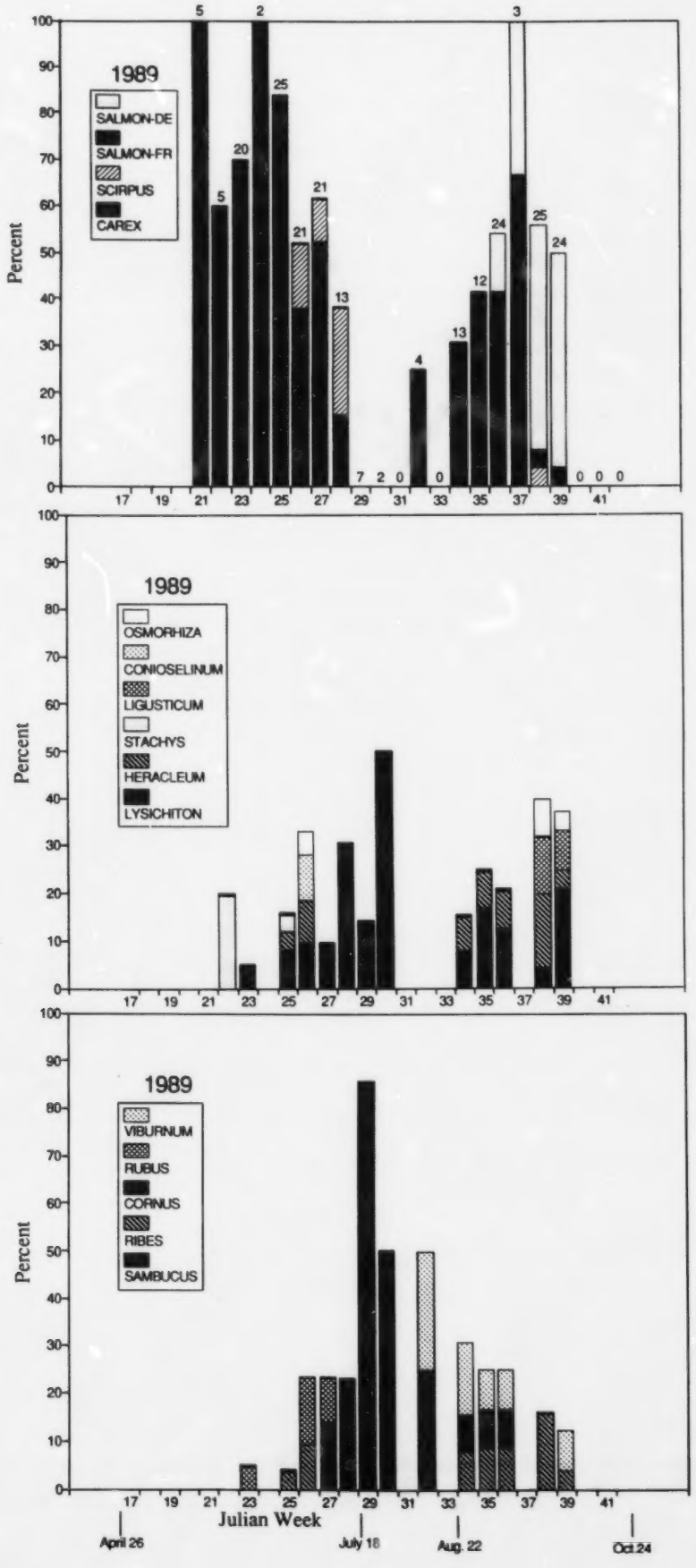


Figure 2. Three seasons of grizzly bear activity were identified for 1989 based on shifts in the use of major food items. Season 1 from den emergence to July18; Season 2 from July 19 to August 22; Season 3 from August 23 to den entrance.

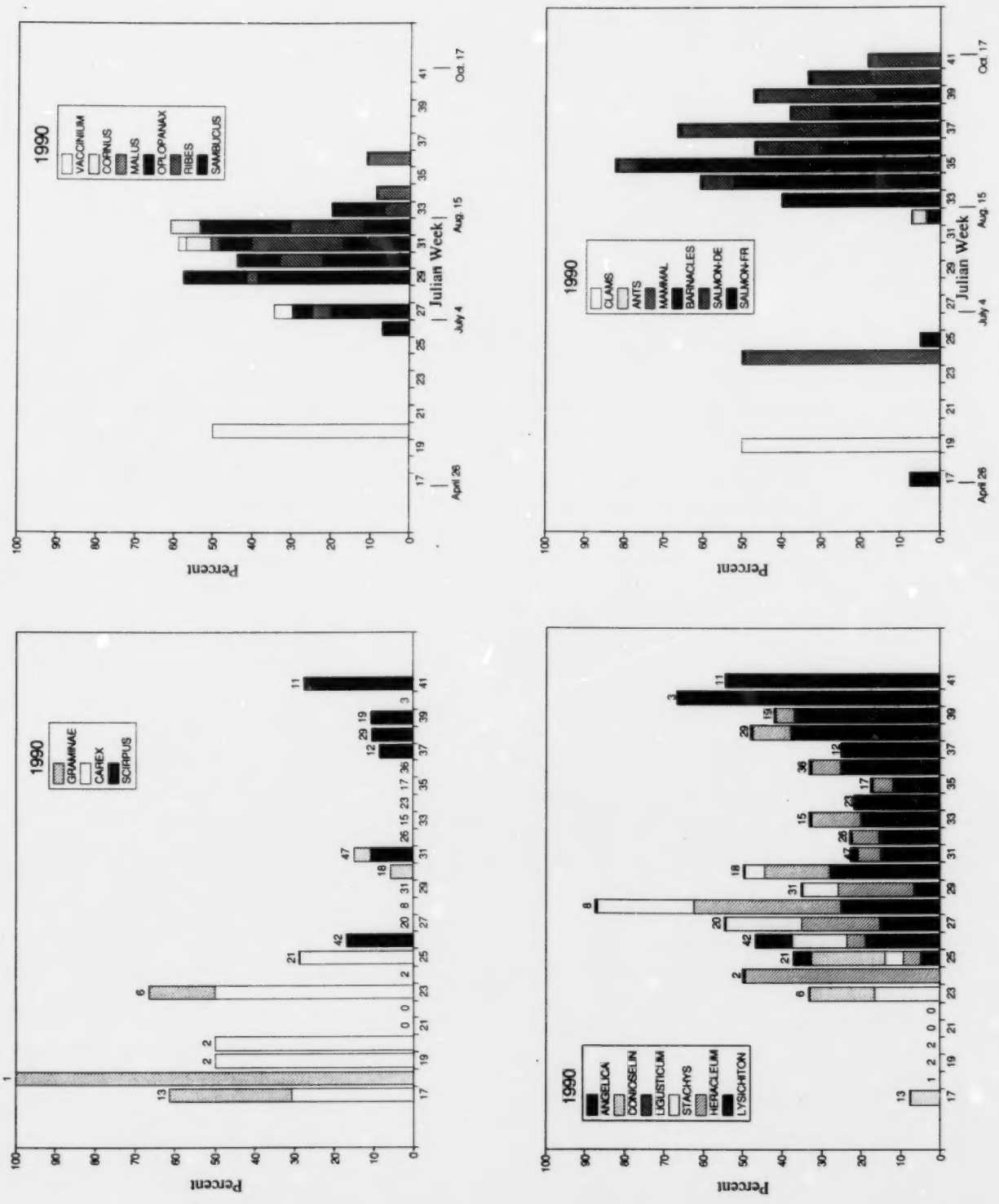


Figure 3. Three seasons of grizzly bear activity were identified for 1990 based on shifts in the use of major food items. Season 1 from den emergence to July 4; Season 2 from July 5 to August 15; Season 3 from August 16 to den entrance.

from 1989). Two other subadult male grizzly bears captured in 1990 for the first time were not radio-collared. Within a week of capture, 1 adult male (GM80) pulled his collar off. The second adult male (GM45) was located until June 11 and then was not located again for the duration of the field season. Two adult females, collared in 1989, retained their collars through the winter of 1989/91. One of these females (GF18) dropped her collar soon after den emergence and the second female (GF34) was killed in early June. Estimates of 100% minimum convex polygon home range sizes for grizzly bears monitored in 1990 are presented in Table 4.

Male GM02

GM02 was 4 years old in 1990. He was first captured in May 1989 along the Khutzeymateen River between the Kateen River and Carm Creek, but was not radio-collared. GM02 was captured near the estuary twice in 1990, at which time he was radio-collared. In 1990, GM02 spent the majority of season 1 on or near the estuary with his brother GM22. We believe this sibling pair also spent much of season 1 in 1989 on or near the estuary. GM02 split with his brother and spent most of season 2 along the lower Khutzeymateen, making the occasional foray toward Carm Creek or up the Kateen River. During season 3 he spent all his time moving up and down the lower Khutzeymateen to the Kateen River and along the lower Kateen to the point where it bends southeast. GM02 denned on a ridge on the north side of the mouth of Mouse Creek (Fig.4). One hundred and thirty six locations for GM02 between April 29 and October 31 resulted in a home range size estimate of 86 km2 (Table 4).

Female GF18

GF18 was 14 years old in 1990. She was first captured in May 1989 along the Khutzeymateen River between the Kateen River and Carm Creek (Nagy and MacHutchon 1991). During the winter of 1989/90 GF18 denned on a northeast facing slope of the upper Khutzeymateen. GF18 left her den between April 10 and April 23, 1990 and remained in the vicinity of her den until she dropped her collar in early May. GF18 had 2 COY in 1990. There were not enough locations for GF18 in 1990 to estimate her spring home range.

Male GM22

GM22 was 4 years old in 1990. He was first captured near the mouth of Carm Creek in May 1989, but was not radio-collared. GM22 was captured near the estuary twice in 1990, at which time he was radio-collared. In 1990, GM22's season 1 activity closely mirrored his brother's, GM02. GM22 spent most of season 2 along the lower Kateen to the point it bends southeast, making occasional forays into the Khutzeymateen below the Kateen and towards Carm Creek. During season 3, GM22 spent all his time moving up and down the lower Kateen and occasionally the lower Khutzeymateen below the Kateen. GM22 denned on a southwest-facing ridge of the lower Kateen River (Fig.5). One hundred and twenty two locations for GM22 between April 29 and October 31 resulted in a home range size estimate of 29 km2 (Table 4).

Female GF26

GF26 was 14 years old in 1990 and was first captured and radio-collared in May 1989 at Carm Lake (*ibid*).

Table 4. Estimates of 100% minimum convex polygon (MCP) home range size for grizzly bears radio-collared in the Khutzeymateen watershed, 1990.

Types of Locations: CAP = capture site; IS = incidental sighting; AT = aerial telemetry; and GT = ground telemetry.

			Types of Locations Used to Estimate Area of MCP					
Bear ID	Sex	Age	CAP	AT	GT	IS	Total	100% MCP (km^2)
GM02	M	4	2	23	43	68	136	86.0
GM22	M	4	2	24	37	59	122	28.8
GF26	F	14	1	25	13	0	49	115.7
GF34	F	7	0	12	15	16	43	7.5[a]
GF40	F	17	2	26	12	1	41	42.7
GF41	F	15	1	24	13	1	39	83.9
GF43	F	24	1	27	5	0	33	44.1

[a] Spring and early summer MCP home range only

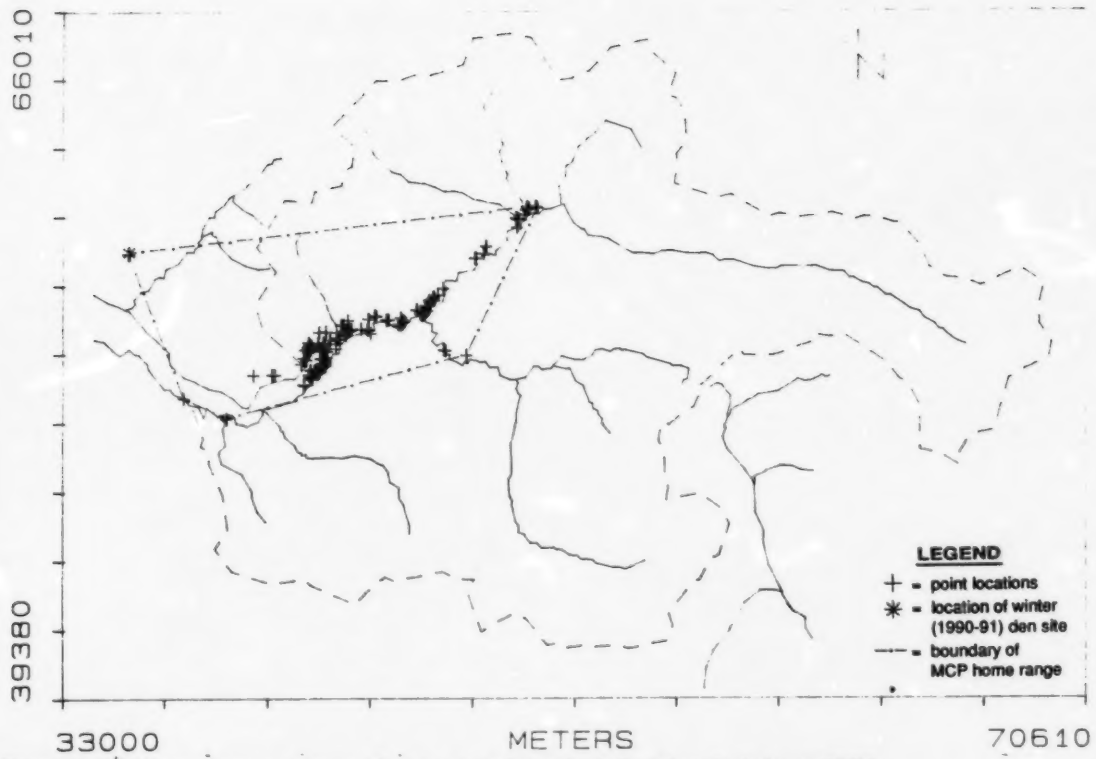


Figure 4. Minimum convex polygon home range for subadult male grizzly bear GM02

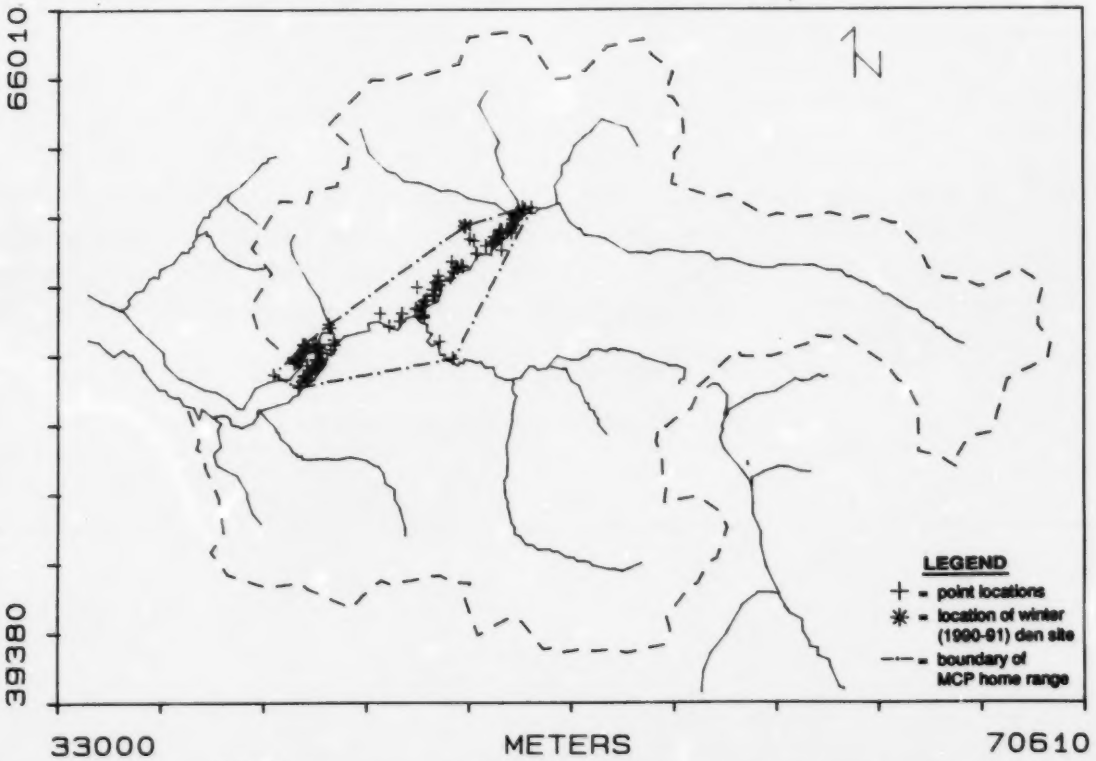


Figure 5. Minimum convex polygon home range for subadult male grizzly bear GM22

In 1989, GF26 dropped her radio-collar during early September. In June 1990, she was captured between the Kateen River and Carm Creek and recollared. GF26 had 3, 4-year-old young accompanying her in 1989, but did not have cubs accompanying her in 1990. GF26 spent most of season 1 during 1990 in Carm Creek and the mid-Khutzeymateen River before moving into the Exchamsiks River at the end of season 1. GF26 spent most of season 2 in the mid and lower Exchamsiks River. During season 3, she spent most of her time in lower Carm Creek, occasionally moving into the mid-Khutzeymateen River. GF26 denned on a south facing ridge above the Khutzeymateen River between the Kateen River and Carm Creek (Fig. 6). Forty nine locations for GF26 between June 2 and October 31 resulted in a home range size estimate of 116 km2 (Table 4).

Female GF34

GF34 was 7 years old in 1990. She was captured and radio-collared in September, 1989 near the Khutzeymateen estuary (*ibid*). GF34 was accompanied by 3 COY in 1989, but only 2 yearlings in 1990. She denned on a northwest facing slope of Mouse Creek during the winter of 1989/90. GF34 emerged from her den between April 10 and April 23, 1990 and was active along the Khutzeymateen Inlet north and south of Mouse Creek and around the mouth of Mouse Creek prior to her death in mid-June (Fig. 7). Forty three locations for GF34 between April 4 and June 21 resulted in a spring home range size of 8 km2 (Table 4).

Female GF40

GF40 was 17 years old in 1990 and was captured in lower Carm Creek in June. GF40 spent season 1 in upper Carm Creek and most of season 2 moving back and forth between the mid and upper Exchamsiks River and Carm Creek. During season 3, GF40 spent her time in the Khutzeymateen River braids or lower Carm Creek. GF40 denned on a north facing slope above Carm Lake (Fig. 8). Forty one locations for GF40 between June 1 and October 31 resulted in a home range size estimate of 43 km2 (Table 4).

Female GF41

GF41 was accompanied by 2 yearlings in 1990 and was captured on the Khutzeymateen estuary in June (15 years old in 1990). GF41 spent part of season 1 on or near the Khutzeymateen estuary before moving into a tributary of Mouse Creek. During season 2, GF41 spent most of her time in heli-logged and adjacent old growth areas of Mouse Creek and Khutzeymateen Inlet. During season 3, GF41 was active along the

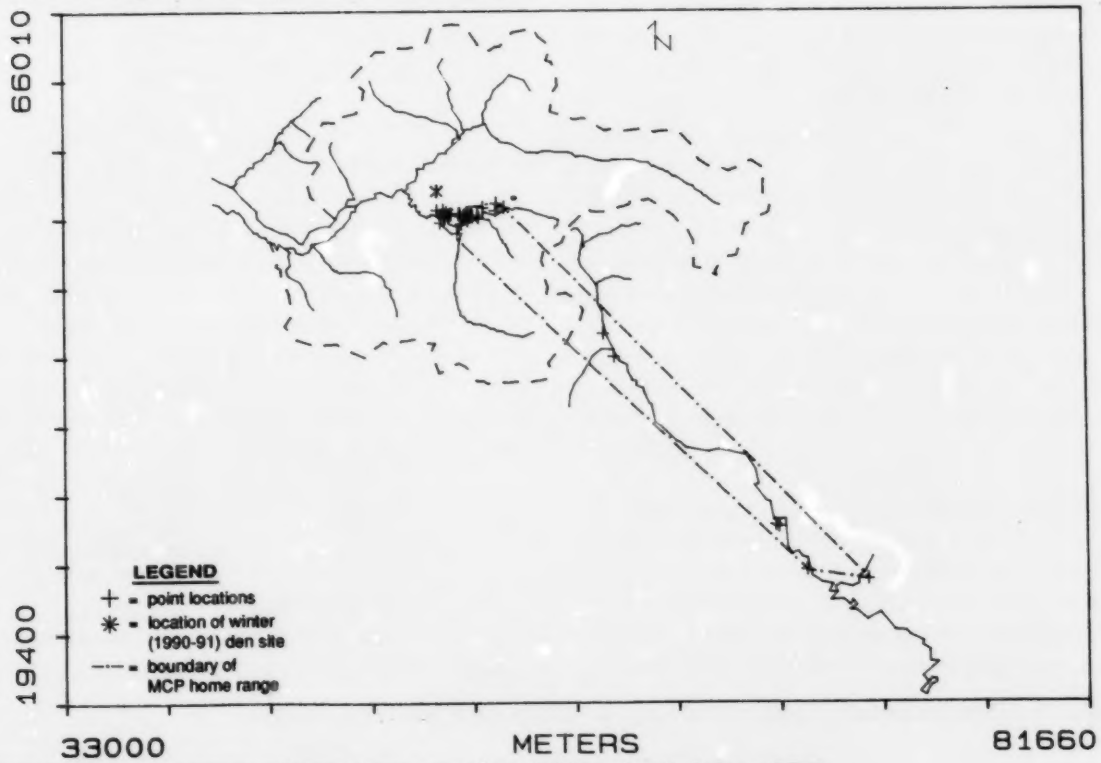


Figure 6. Minimum convex polygon home range for adult female grizzly bear GF26.

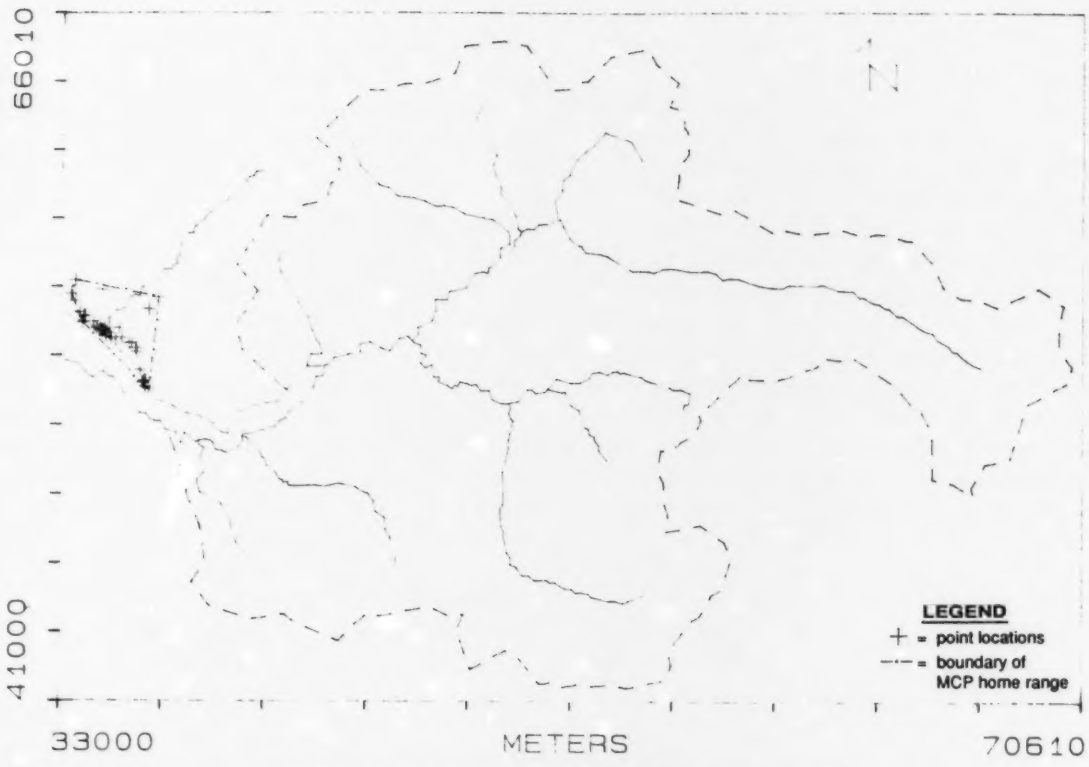


Figure 7. Minimum convex polygon home range for adult female grizzly bear GF34.

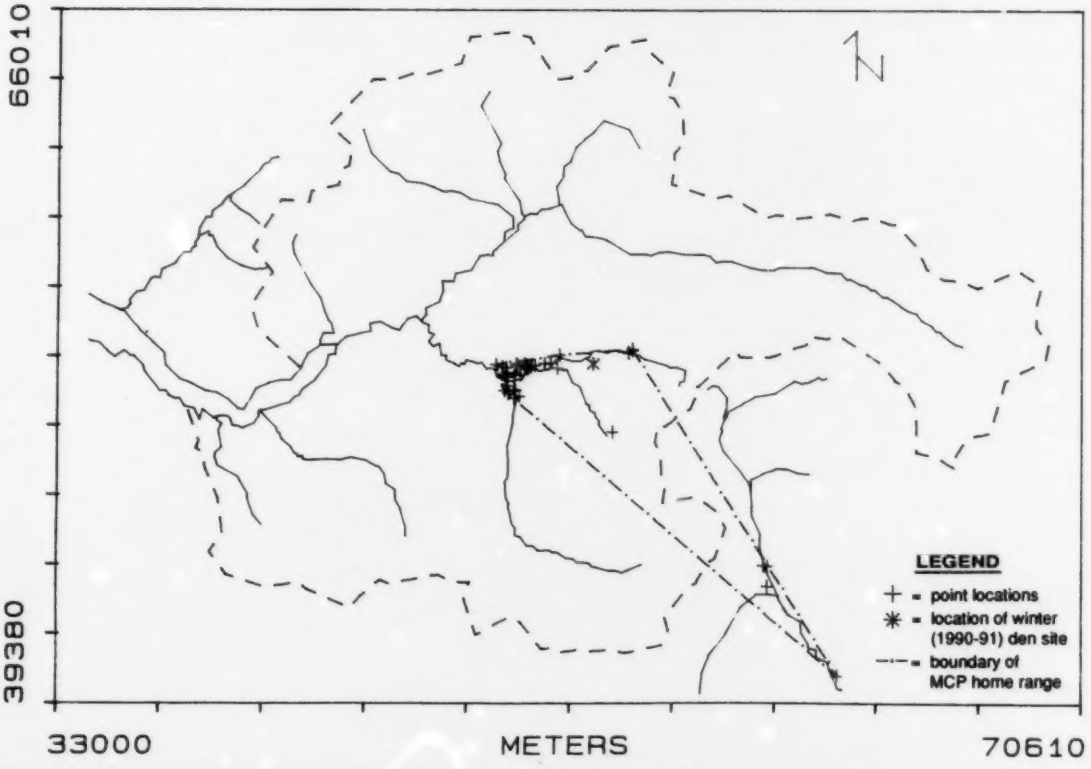


Figure 8. Minimum convex polygon home range for adult female grizzly bear GF40.

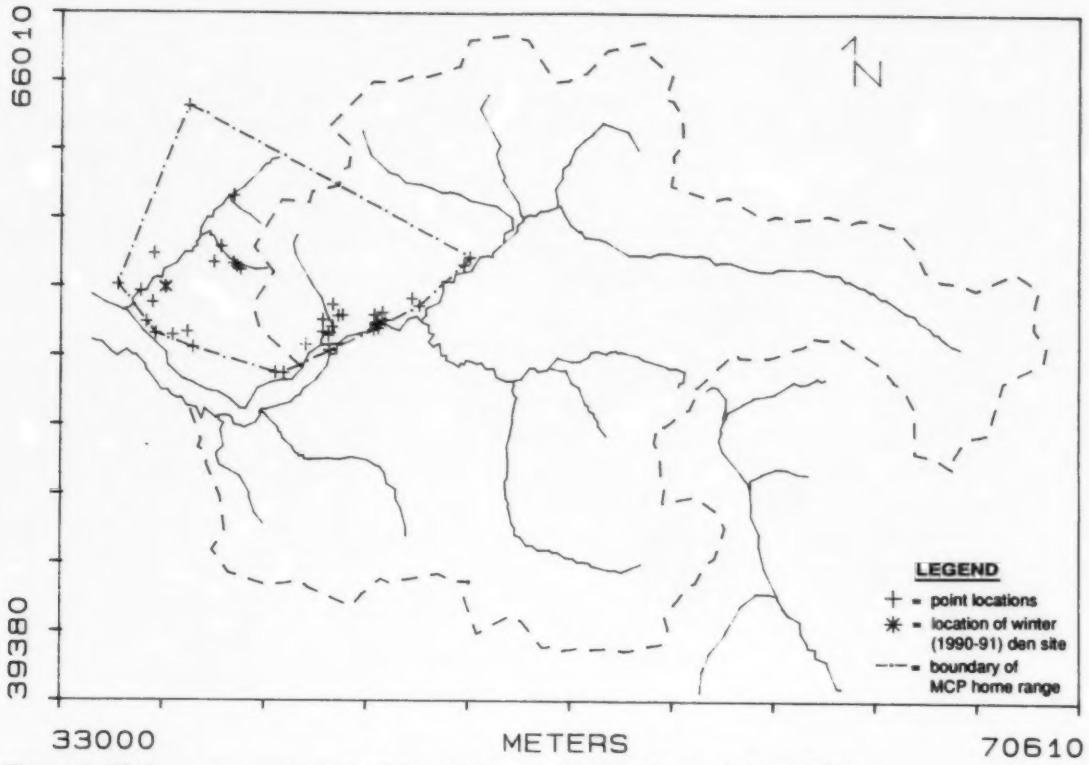


Figure 9. Minimum convex polygon home range for adult female grizzly bear GF41.

lower Kateen River and lower Khutzeymateen River below the Kateen. GF41 denned on a northwest facing slope of Mouse Creek (Fig. 9). Thirty nine locations for GF41 between June 5 and October 31 resulted in a home range size estimate of 84 km2 (Table 4).

Female GF43

GF43 was 24 years old in 1990 and was captured at Carm Lake in June. GF43 spent season 1 in upper Carm Creek with one foray to the upper Exchamsiks River and spent several weeks of season 2 in the upper Exchamsiks River before spending the remainder of season 2 in Carm Creek. During season 3, GF43 spent her time in mid and upper Carm Creek. GF43 denned on a south facing ridge of upper Carm Creek (Fig. 10). Thirty three locations for GF43 between June 5 and October 31 resulted in a home range size estimate of 44 km2 (Table 4).

4.5 Habitat use

4.5.1 Methods.— Aerial telemetry and ground telemetry location data were collected using the methods described in section 4.4 and Nagy and MacHutchon (1991). When a grizzly bear moved away from the area where it was located, a ground investigation of the location was conducted. Considerable effort was taken to verify that sites of grizzly bear activity corresponded to the location of the radio-collared bear. Verification criteria included some or all of the following: the presence of grizzly bear hair, the presence of appropriately sized grizzly bear tracks, proximity of the activity to the point of location, whether the bear was seen, the relative age of the sign, the presence of scats, and the nature of the disturbance. When a researcher was confident that an activity site corresponded to a ground or aerial location, a site investigation was carried out (*ibid*). Each site of activity was assigned to one of the ecosystem units of the Khutzeymateen study area described by Clement (1990) (Table 5).

Occasionally, aerial telemetry locations of grizzly bears were inaccessible, were not visited, or were visited but insufficient sign was found to warrant a site investigation. These locations were assigned to an ecosystem unit based on interpretation of site characteristics from the air at the time of location. Ground

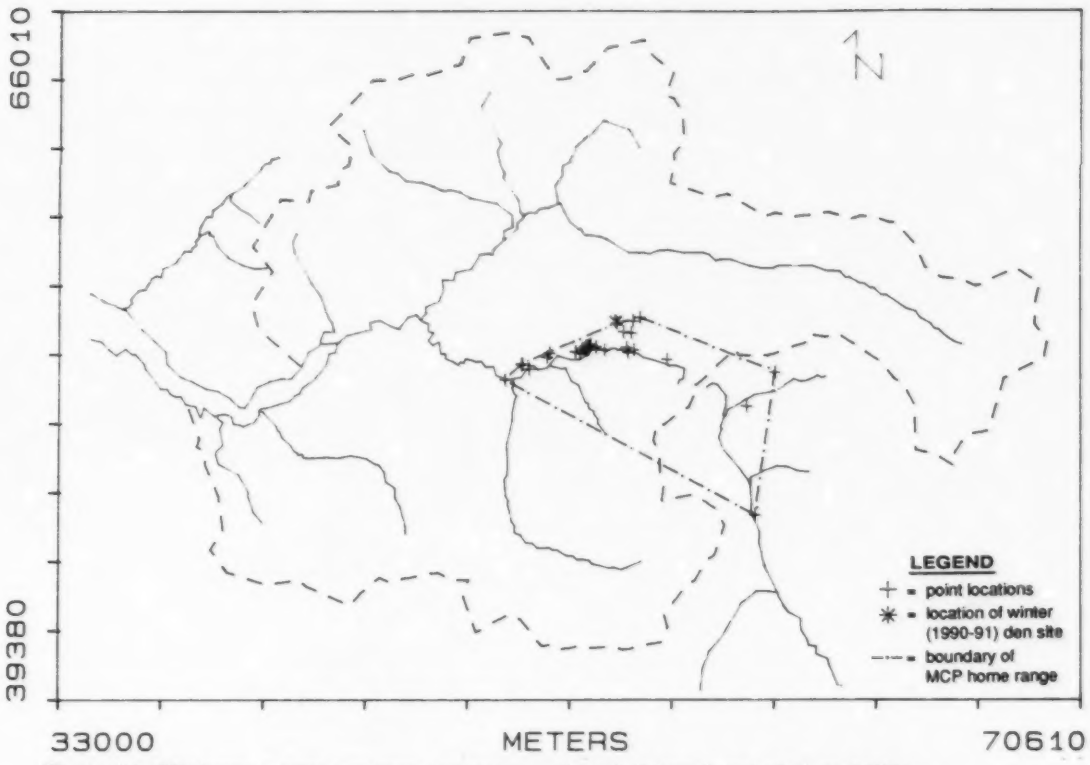


Figure 10. Minimum convex polygon home range for adult female grizzly bear GF43.

telemetry locations that were not visited were assigned to an ecosystem unit if the location was within a simple mapped polygon or the bear was seen during telemetry.

Incidental sightings of radio-collared grizzly bears that did not occur during aerial or ground telemetry were occasionally used for subsequent site investigation. This was especially true for incidental sightings of GM02 and GM22 on the estuary before they were captured and radio-collared. Often, an incidental sighting led to the discovery of an activity site in an adjacent ecosystem unit. Site investigations at these points helped reduce the bias associated with the greater visibility of grizzly bears in certain habitat units.

In addition to investigations done at locations of radio-collared grizzly bears or points of incidental observation, investigations were conducted at sites of activity found incidentally while researchers travelled through the watershed.

Den sites were located in February 1990, using a Bell 206 helicopter. The location of each den site was plotted on 1:14 000 air photos. A 1 m diameter hoop, equipped with a transmitting device and wrapped with coloured flagging, was placed on top of a tree at or near the den site for subsequent location.

4.5.2 Results and Discussion. — Figure 11 illustrates the number and chronology of site investigations conducted in the Khutzeymateen study area and adjacent locations during 1989 (n=125) and 1990 (n=280). The majority of site investigations in both 1989 and 1990 were done during the salmon season (season 3). Season 2 activities were much better represented in 1990 than 1989, but in both years there was relatively poor representation of season 1 activities.

There were several reasons for the skewed distribution of site investigations over time. In both 1989 and 1990, there were few or no radio-collared bears to track during the early spring, and those available were inaccessible or outside the study area. Trapping occurred for 3 weeks in 1989 and 2 weeks in 1990 during which time no site investigations were done. Jet-boat problems, logistic support for other groups working in the valley and access difficulties slowed the field research in season 2, 1989. In both years, radio-

Table 5. Biogeoclimatic zones and subzones, ecosystem units, seral associations where applicable, and successional stages mapped for the Khutzeymateen watershed and Larch and Cedar drainages by Clement (1990).

Zone[a]	Subzones[b]	Unit Label	Major Vegetation Association	Seral Association	General Vegetation of Seral Association	Successional Stages[c]
CWH	vm	CM	Cedar-moss	n/a	n/a	6-7
CWH	vm	HM	Hemlock-moss	n/a	n/a	3-7
CWH	vm & wm	BM	Blueberry-moss	n/a	n/a	3-7
CWH	vm & wm	FF	Fern-foamflower	n/a	n/a	5-7
CWH	vm & wm	DC	Devil's club	n/a	n/a	1-7
CWH	vm & wm	FD	Floodplain devil's club	FD(1)	Alder-willow-Rhacomitrium-riverbar	1-5
CWH				FD(2)	Alder-salmonberry	3-5
CWH				FD(3)	Alder-elderberry	3-5
CWH				FD(5)	Salmonberry—red-osier dogwood	3-6
CWH				FD(6)	Cottonwood-alder-salmonberry	4-6
CWH				FD(8)	Cottonwood-spruce-salmonberry-devil's club	3-7
CWH				FD(9)	Cottonwood-alder-stink currant	3-6
CWH	vm & wm	SC	Skunk cabbage	n/a	n/a	3-7
CWH	vm	ES	Estuary	n/a	n/a	2-3
CWH, MH	vm, wm, mf	NW	Non-forested wetland	n/a	n/a	2-3
CWH, MH	vm, wm, mf	AV	Avalanche track	n/a	n/a	1-3
CWH, MH	vm, wm, mf	RO	Rock outcrop	n/a	n/a	1
CWH, MH	vm, wm, mf	OW	Open water	n/a	n/a	n/a
MH	mf	MM	Mountain hemlock-moss	n/a	n/a	3-7
MH	mf	HF	Hellebore-fern	n/a	n/a	1-7
MH	mf	SS	Subalpine scrub	n/a	n/a	3-7
MH	mf	FW	Forested wetland	na	n/a	7
MH	p	PA	Parkland	n/a	n/a	1-2
AT	n/a	AT	Alpine tundra	n/a	n/a	1-2

[a]Zone: CWH = Coastal Western Hemlock; MH = Mountain Hemlock; AT = Alpine Tundra.

[b]Subzone: vm = very wet maritime; wm = wet maritime; mf = forested; p = parkland.

[c]Successional stages: 1 = Non-vegetated; 2 = Herb; 3 = Shrub; 4 = Pole - sapling; 5 = Young forest; 6 = Mature forest; 7 = Old-growth

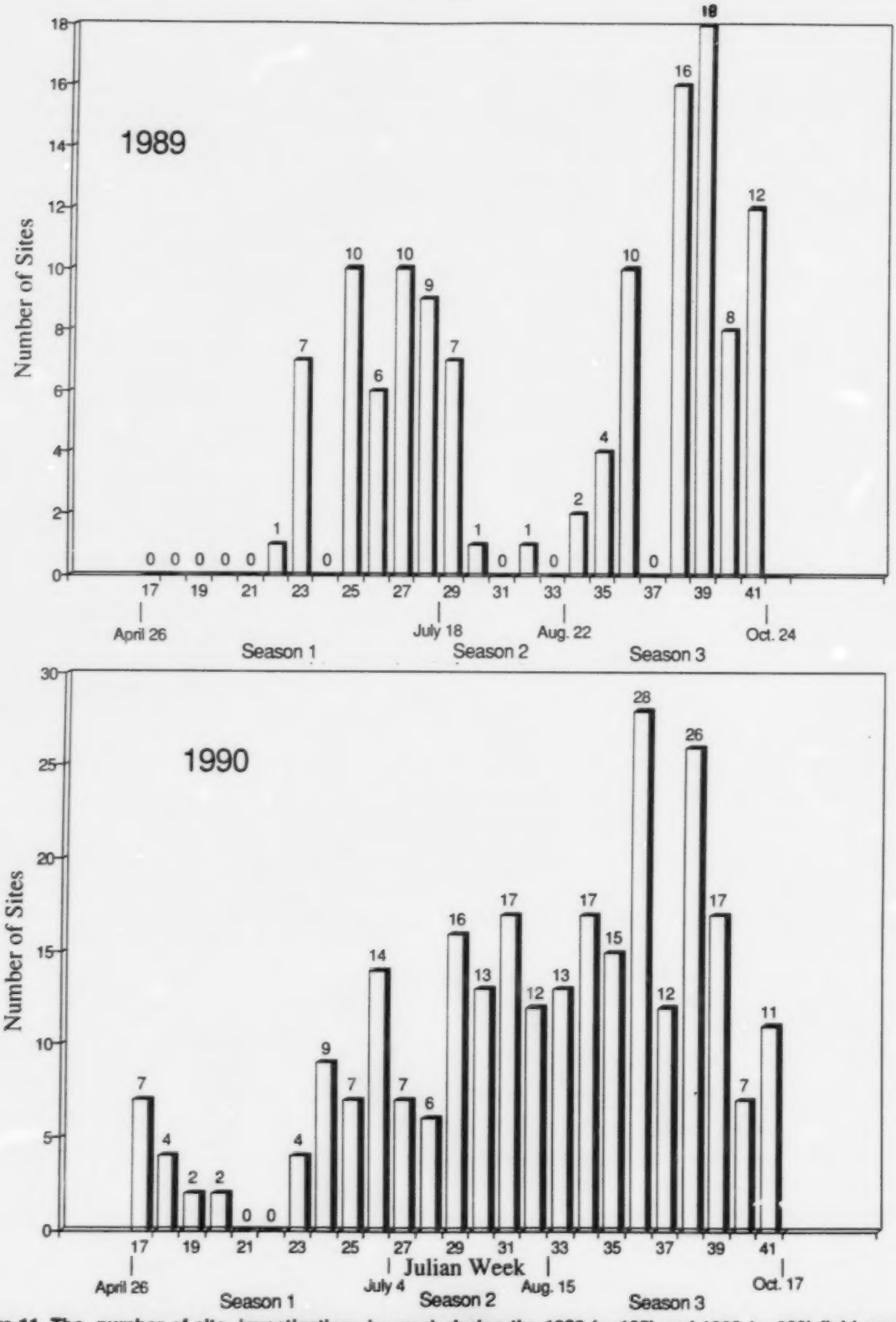


Figure 11. The number of site investigations by week during the 1989 (n=125) and 1990 (n=280) field seasons. Some site investigations in 1989 and 1990 occurred before or after the time frame illustrated.

collared bears were more accessible and travel was easier during season 3. In addition, there were a number of extra field personnel helping to collect data in season 3, 1990.

During the 1990 field season, a total of 280 site investigations were conducted (Table 6). This total includes investigations done at aerial and ground telemetry locations, points of incidental observation, sites adjacent to points of incidental observation, and sites found incidentally while travelling in the study area. Some site investigations were conducted outside the study area. The primary activities of focus during site investigations were bedding and feeding.

In 1990, radio-collared grizzly bears were located 163 times from the air for which 59 site investigations (36%) were done and 139 times on the ground for which 80 site investigations (58%) were done (Table 7). Locations and site investigations outside the study area were not included in the following summary.

General patterns of habitat use for radio-collared grizzly bears are described in this report and only use of habitats within the study area mapped by Clement (1990) are included. Table 8 summarizes the types of locations used to describe habitat use by radio-collared grizzly bears. A total of 233 locations within definable ecosystem units were recorded. Detailed site investigations were done at 70% (163) of these locations. Two subadult male bears, GM02 and GM22, were responsible for 60% (97 of 163) of the total site investigations and 58% (134 of 233) of the total locations included.

Table 9 outlines the seasonal distribution by ecosystem unit and Table 10 outlines the primary activity by ecosystem unit for all locations of radio-collared grizzly bears in the Coastal Western Hemlock zone. Estuary (ES) and Avalanche tracks (AV) received the highest use of any ecosystem unit in season 1 and they were used almost exclusively for feeding. Use of these units tapered off in seasons 2 and 3. Non-forested wetland (NW) ecosystem units were used exclusively for feeding in all seasons.

The Blueberry-moss/ Fern-foamflower (BM-FF) mature and old-growth ecosystem units were used primarily for bedding in all seasons whereas the Devil's club (DC) mature and old growth units were used for bedding and feeding. The data as presented in tables 9 and 10 do not indicate the seasonal split between bedding and feeding in Devil's club units. Generally, more feeding than bedding occurred in the Devil's club units in season 1 and 2 and the opposite was true in season 3.

The early successional Floodplain devil's club (FD) ecosystem units received considerable use in season 3. This use was primarily by grizzly bears feeding on salmon along riverbars. In season 2, use of these ecosystem units was most often by bears feeding on berries in shrub dominated units. The mature and old-growth Floodplain devil's club ecosystem units received the most use in seasons 2 and 3. These units were used for both feeding and bedding in season 2, but in season 3 they were most often used for bedding.

Skunk cabbage (SC) ecosystem units were primarily used for feeding in all seasons, but there was often bedding on higher ground in the same unit.

The den sites of two adult females were visited on the ground and described during 1990. Detailed information on den characteristics were collected, but are not included in this report. The den site of GF18 was

Table 6. The primary activity recorded at site investigations during 1990. All site investigations conducted in 1990 are included in the table.

Primary Activity	New Sites	Reused Sites	Total Sites	Percent
Bedding	78	8	86	31
Feeding	111	50	161	57
Mark Tree	20	3	23	8
Travel	2	4	6	2
Den	2	0	2	1
Other	2	0	2	1
TOTAL	215	65	280	100

Table 7. Total number of aerial and ground telemetry locations of radio-collared grizzly bears obtained in 1990 and the number which resulted in a site investigation. This table includes locations outside the study area.

Bear	Aerial Telemetry Loc	Aerial Telemetry Sites	Aerial Telemetry %	Ground Telemetry Loc	Ground Telemetry Sites	Ground Telemetry %
GM02	23	11	48	43	27	63
GM22	24	9	38	37	24	65
GF26	25	11	44	13	9	69
GF40	26	10	38	12	6	50
GF41	24	10	42	13	7	54
GF43	27	5	19	5	3	60
GF34	12	2	17	15	4	27
GF18	5	1	20	0	0	0
GM45	2	1	50	0	0	0
GM80	2	0	0	0	0	0
TOTAL	170	59	35	138	80	58

located in the upper Khutzeymateen River at 400 m on a northeast facing slope. The den was an excavation under the root mass of a large diameter Sitka spruce tree situated at the edge of a finger of trees between 2 avalanche tracks. The den site of GF34 was located in Mouse Creek at 520 m on a west facing slope. The den was an excavation under the root mass of a large diameter Western redcedar, also situated in a finger of trees between 2 small avalanche tracks.

4.6 Other Wildlife

Observations of other wildlife using the watershed and the head of Khutzeymateen Inlet were recorded during the daily field operations of the Khutzeymateen valley grizzly bear study.

Five helicopter surveys were flown in the watershed between May 1 and May 21, 1989 to search for grizzly bears or their sign, at which time all observations of black bears and goats were recorded (Nagy and MacHutchon 1991). Figure 12 shows the distribution of all black bear observations and Figure 13 shows the distribution of all goat observations during these surveys.

Table 11 lists all mammal species observed and identified in the Khutzeymateen study area during the 1989 and 1990 field seasons.

Table 12 lists the number of bird species in eight major categories that were observed or identified in the Khutzeymateen study area during 1990. Appendix 2 is

Table 8. The types of locations used to describe habitat use for radio-collared grizzly bears in the Khutzeymateen study area during 1990.

AT=Aerial Telemetry; GT=Ground Telemetry; IV=Incidental Visual; IF=Incidental Find.

Bear	Habitat Described by Site Investigation AT	GT	IV	IF	Habitat Described Remotely AT	GT	Total
GM02	11	27	11	4	9	10	72
GM22	9	24	5	6	12	6	62
GF26	11	9	0	0	5	0	25
GF40	10	6	1	0	11	0	28
GF41	6	7	1	3	2	1	20
GF43	5	3	0	4	14	0	26
TOTAL	52	76	18	17	53	17	233

Table 9. The seasonal breakdown by ecosystem unit for locations of radio-collared grizzly bears in the Coastal Western Hemlock (CWH) zone of the Khutzeymateen study area, 1990.

			Season[c]						
Sub-zone[a]	Eco-system Unit	Succ. Stage[b]	1		2		3		% of Total
			#	%	#	%	#	%	
vm	BM-FF	4,5	0	0.0	0	0.0	0	0.0	0.0
wm	BM-FF	4,5	0	0.0	0	0.0	0	0.0	0.0
vm	BM-FF	6,7	4	8.3	3	4.8	2	1.6	3.9
wm	BM-FF	6,7	4	8.3	3	4.8	11	8.9	7.7
vm	DC	4,5	2	4.2	0	0.0	0	0.0	0.9
wm	DC	4,5	0	0.0	1	1.6	0	0.0	0.4
vm	DC	6,7	4	8.3	5	8.1	2	1.6	4.7
wm	DC	6,7	0	0.0	5	8.1	8	6.5	5.6
vm	CM	4,5	0	0.0	0	0.0	0	0.0	0.0
vm	CM	6,7	2	4.2	0	0.0	0	0.0	0.9
wm	HM	4,5	1	2.1	1	1.6	0	0.0	0.9
wm	HM	6,7	0	0.0	0	0.0	0	0.0	0.0
vm	SC	1,2,3	0	0.0	0	0.0	4	3.3	1.7
wm	SC	1,2,3	0	0.0	0	0.0	0	0.0	0.0
vm	SC	4,5	0	0.0	0	0.0	1	0.8	0.4
wm	SC	4,5	1	2.1	4	6.5	4	3.3	3.9
vm	SC	6,7	1	2.1	3	4.8	4	3.3	3.4
wm	SC	6,7	0	0.0	2	3.2	6	4.9	3.4
vm	FD	1,2,3	0	0.0	1	1.6	4	3.3	2.1
wm	FD	1,2,3	2	4.2	3	4.8	36	29.3	17.6
vm	FD	4,5	0	0.0	0	0.0	2	1.6	0.9
wm	FD	4,5	0	0.0	7	11.3	8	6.5	6.4
vm	FD	6,7	0	0.0	3	4.8	3	2.4	2.6
wm	FD	6,7	0	0.0	8	12.9	23	18.7	13.3
vm	ES		12	25.0	5	8.1	0	0.0	7.3
vm,wm	AV	2,3	11	22.9	5	8.1	0	0.0	6.9
vm, wm	NW	2,3	4	8.3	3	4.8	2	1.6	3.9
vm, wm	OW		0	0.0	0	0.0	3	2.4	1.3
	TOTAL		48	100.0	62	100.0	123	100.0	100.0

[a] Subzone: vm = very wet maritime; wm = wet maritime

[b] Successional stages: 1 = Non-vegetated; 2 = Herb; 3 = Shrub; 4 = Pole-sapling; 5 = Young Forest; 6 = Mature forest; 7 = Old-growth

[c] Season 1 = emergence to July 4; Season 2 = July 5 to August 15; Season 3 = August 16 to October 17.

Table 10. The main activity by ecosystem unit for site investigations of radio-collared grizzly bear locations in the Coastal Western Hemlock (CWH) zone of the Khutzeymateen study area, 1990.

Sub-zone[a]	Eco-system Unit	Succ. Stage[b]	Activity						% of Total
			Feed		Bed		Other		
			#	%	#	%	#	%	
vm	BM-FF	4,5	0	0.0	0	0.0	0	0.0	0.0
wm	BM-FF	4,5	0	0.0	0	0.0	0	0.0	0.0
vm	BM-FF	6,7	0	0.0	3	5.8	3	30.0	3.7
wm	BM-FF	6,7	1	1.0	7	13.5	0	0.0	4.9
vm	DC	4,5	1	1.0	0	0.0	0	0.0	0.6
wm	DC	4,5	0	0.0	1	1.9	0	0.0	0.6
vm	DC	6,7	2	2.0	5	9.6	0	0.0	4.3
wm	DC	6,7	3	3.0	2	3.8	0	0.0	3.1
vm	CM	4,5	0	0.0	0	0.0	0	0.0	0.0
vm	CM	6,7	0	0.0	2	3.8	0	0.0	1.2
wm	HM	4,5	0	0.0	0	0.0	0	0.0	0.0
wm	HM	6,7	0	0.0	0	0.0	0	0.0	0.0
vm	SC	1,2,3	4	4.0	0	0.0	0	0.0	2.5
wm	SC	1,2,3	0	0.0	0	0.0	0	0.0	0.0
vm	SC	4,5	1	1.0	0	0.0	0	0.0	0.6
wm	SC	4,5	3	3.0	1	1.9	0	0.0	2.5
vm	SC	6,7	6	5.9	2	3.8	0	0.0	4.9
wm	SC	6,7	4	4.0	2	3.8	0	0.0	3.7
vm	FD	1,2,3	3	3.0	0	0.0	4	40.0	4.3
wm	FD	1,2,3	25	24.8	3	5.8	0	0.0	17.2
vm	FD	4,5	1	1.0	0	0.0	1	10.0	1.2
wm	FD	4,5	9	8.9	4	7.7	0	0.0	8.0
vm	FD	6,7	3	3.0	1	1.9	2	20.0	3.7
wm	FD	6,7	6	5.9	18	34.6	0	0.0	14.7
vm	ES		8	7.9	0	0.0	0	0.0	4.9
vm,wm	AV	2,3	10	9.9	1	1.9	0	0.0	6.7
vm, wm	NW	2,3	9	8.9	0	0.0	0	0.0	5.5
vm, wm	OW		2	2.0	0	0.0	0	0.0	1.2
	TOTAL		101	100.0	52	100.0	10	100.0	100.0

[a] Subzone: vm = very wet maritime; wm = wet maritime

[b] Successional stages: 1 = Non-vegetated; 2 = Herb; 3 = Shrub; 4 = Pole-sapling; 5 = Young Forest; 6 = Mature forest; 7 = Old-growth

Table 11. Mammal species or their sign identified in the Khutzeymateen watershed and head of Khutzeymateen Inlet during 1989 and 1990.

Common Name	Scientific Name	Sightings[a]
Hoary Marmot	*Marmota caligata*	Uncommon
Red Squirrel	*Tamiasciurus hudsonicus*	Common
Beaver	*Castor canadensis*	Common
Deer Mouse	*Peromyscus maniculatus*	Common
Long-tailed Vole	*Microtus longicaudus*	Uncommon
Porcupine	*Erethizon dorsatum*	Common
Killer Whale	*Orcinus orca*	Uncommon
Gray Whale	*Eschrichtius robustus*	Rare migrant
Humpback Whale	*Megaptera novaeangliae*	Rare migrant
Gray Wolf	*Canis lupus*	Occasional
Black Bear	*Ursus americanus*	Common
Grizzly Bear	*Ursus arctos*	Common
Marten	*Martes americana*	Common
Fisher	*Martes pennanti*	Introduced, rare
Mink	*Mustela vison*	Occasional
Wolverine	*Gulo gulo*	Occasional
River Otter	*Lutra canadensis*	Common
Harbour Seal	*Phoca vitulina*	Common
Sitka Deer	*Odocoileus hemionus*	Rare
Moose	*Alces alces*	Rare
Mountain Goat	*Oreamnos americanus*	Common

[a]Sightings: Common = > 30; Occasional = < 10; Uncommon = < 5; Rare = 1.

a complete list of all bird species identified and the distribution of recorded observations by week between April 22 and October 20, 1990.

4.7 Human Use

All human visitors to the head of the Khutzeymateen Inlet and the Khutzeymateen valley proper between April 15 and October 23, 1990 were recorded. Table 13 outlines the category of visitor and the number of person days per visitor category over the period of record. Included in Table 13 are activities by individuals involved in the Khutzeymateen Project. The grizzly bear study accounted for 40% of all person days. Visitors not associated with the Khutzeymateen Project rarely ventured farther upriver than the head of the Khutzeymateen River estuary. This was particularly true for recreational visitors and commercial fishing operations.

4.8 Public Awareness

Talks on the Khutzeymateen Project, particularly the grizzly bear study component, were given to various groups in 1990 and early 1991, including classes of Westview Elementary School and Pineridge Elementary School in Prince Rupert, a Student Pugwash workshop in Vancouver, graduate students of Simon Fraser University Biology Department in Burnaby, a Grizzly Bear Management Workshop in Revelstoke, the Prince Rupert Rod and Gun Club, a Prince Rupert sorority, the Prince Rupert Masons, staff of the North Coast Forest District in Prince Rupert, regional staff of Ministry of Forests and Ministry of Environment in Smithers, staff of Ministry of Environment Wildlife Branch in Victoria, and a provincial Wildlife Biologists meeting in Victoria.

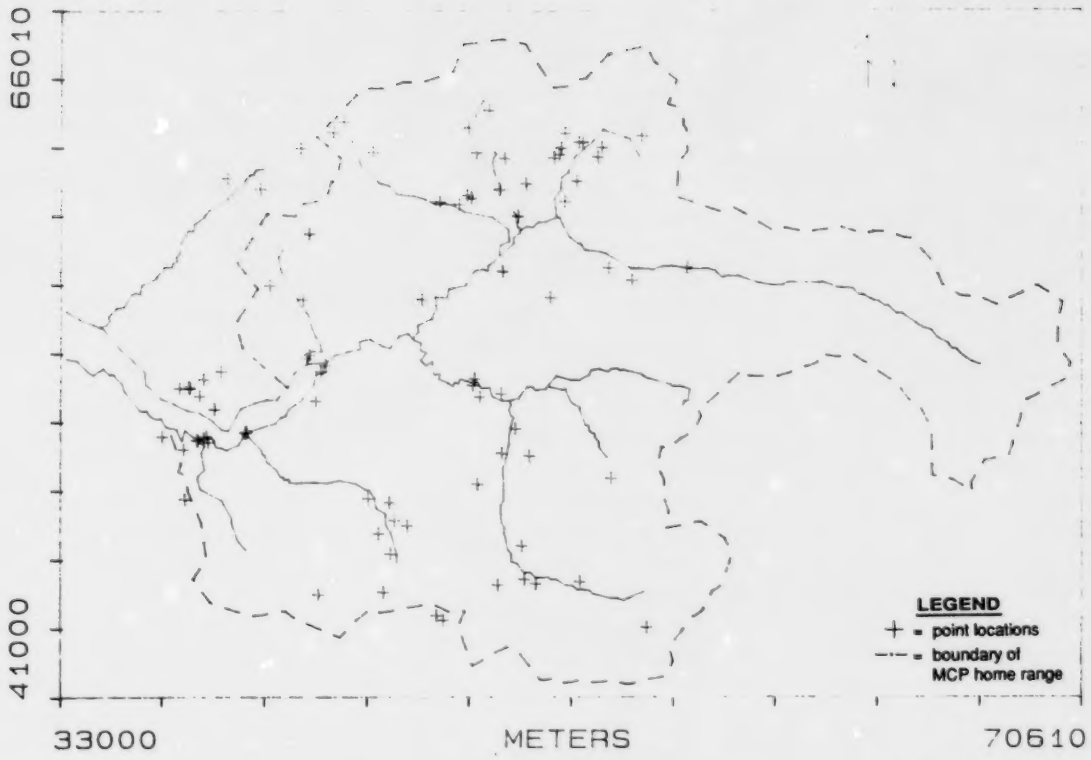


Figure 12. The distribution of black bear observations during helicopter surveys in May 1989.

Table 12. The number of bird species in each of 8 major groups identified in the Khutzeymateen watershed and head of Khutzeymateen Inlet during 1990.

Category	Number of Species
Waterfowl	21
Raptors and owls	11
Grouse	1
Shorebirds	5
Gulls	7
Swifts and hummingbirds	3
Woodpeckers and Kingfishers	4
Passerines	34

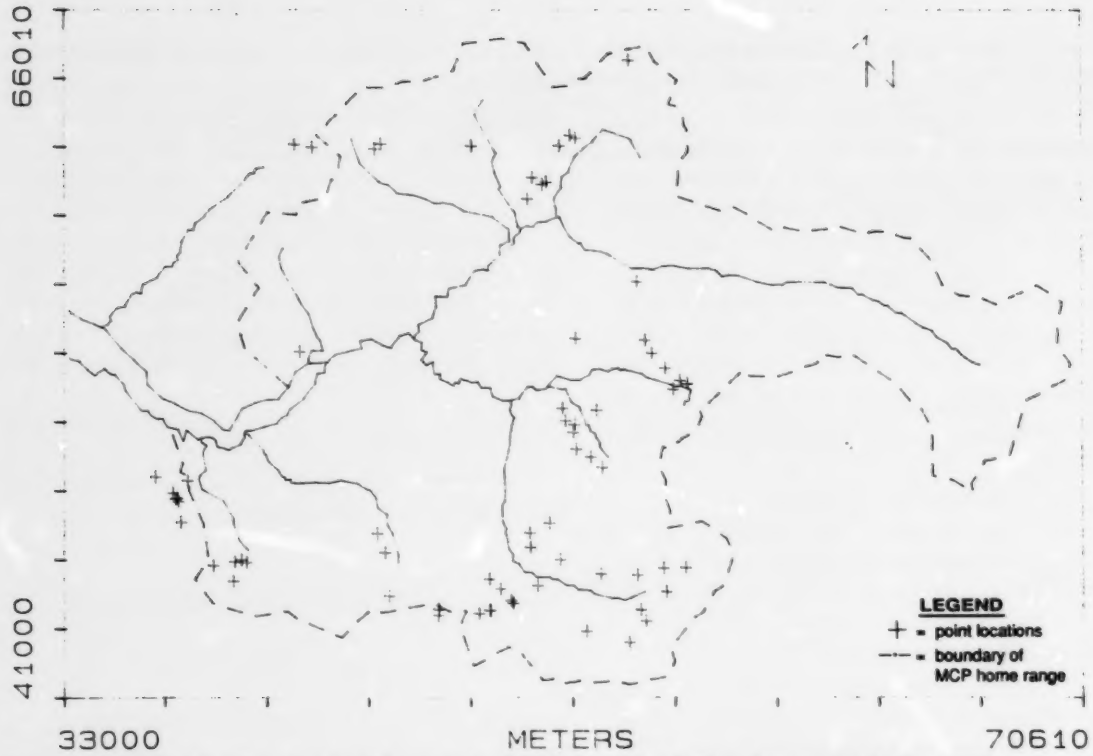


Figure 13. The distribution of mountain goat observations during helicopter surveys in May 1989.

5.0 SUMMARY

1. Trapping was conducted from May 22 to June 5, and 13 grizzly and 4 black bears were captured. Eight grizzly bears were fitted with radio-collars, including 4 adult females, 2 adult males, and 2 subadult males.

2. A minimum of 43 different grizzly bears used the Khutzeymateen study area during at least one season in 1990.

3. A minimum of 19 different grizzly bears used the Khutzeymateen estuary during the spring, a minimum of 9 different grizzly bears used lower Carm Creek during the salmon spawning period and a minimum of 24 different grizzly bears used the lower Khutzeymateen and Kateen Rivers during the salmon spawning period.

4. Grizzly bears used 42 different food items during 3 general seasons of activity: 1) Greens - Den emergence to July 4; 2) Berries - July 5 to August 15; and 3) Salmon - August 16 to den entrance.

5. Sufficient movement data was collected for 2 subadult male grizzly bears and 4 adult females to estimate 100% Minimum Convex Polygon home range size. Home range size ranged from 29 - 86 km^2 for the males and 44 - 116 km^2 for the females. One other female had a spring home range of 8 km^2.

6. Estuary, avalanche track, and non-forested wetlands were the most frequently used habitat unit for feeding during season 1. Early successional, mature and old-growth floodplain habitats were used most often for feeding in season 2. Early successional floodplain habitats associated with salmon spawning watercourses were used most often for feeding in season 3. Mature and old-growth floodplain habitats and sidehill mature and old-growth habitats were used most often for bedding in all seasons.

Table 13. Human use of the Khutzeymateen watershed and head of Khutzeymateen Inlet during 1990. Totals include all the activities of individuals involved in the Khutzeymateen Project.

Category	Number of People	Person Days
1. Recreational Visitors		
-Fishermen		
-Sightseers		
-Amateur Photographers	136	400
2. Professional Photographers	14	194
3. Commercial Fishing		
-crabs, prawns, bottom fish	19	40
4. Dept. of Fisheries & Oceans		
-Salmon Escapement Surveys		
-Fisheries Charters		
-Stream Reach Classification	32	5
5. Ministry of Parks		
-Reconnaissance	4	12
6. Ministry of Forests		
-Forestry Economics/Engineering		
-Porcupine Damage Surveys		
-Old Growth Research	48	99
7. Grizzly Bear Study		
-Logistical Support		
-Trapping		
-Field Work Assistants	20	552
TOTAL	293	1378

7. The den sites of two adult female grizzly bears were described in 1990. Both dens were excavations under the root mass of a large diameter tree situated in a finger of trees between 2 avalanche chutes. Both were higher than 400 m above sea level.

8. All mammal and bird species incidentally observed in the Khutzeymateen study area were recorded and lists are included.

9. A total of 594 person days of human activity were recorded for the head of Khutzeymateen Inlet and the Khutzeymateen River by recreational visitors and professional photographers in 1990.

6.0 1991-1992 WORKING PLAN

The purpose of this working plan is to outline the objectives of the 1991-1992 field season of the Khutzeymateen Valley Grizzly Bear Study, and describe the methods that will be employed to address each objective. This annual plan is consistent with meeting the objectives of the overall study working plan (Hamilton and Nagy 1990).

After completion of the 1989 and 1990 field programs, data gaps were evident that reduce the study's ability to adequately meet some of its objectives (*ibid*). The objectives for the 1991 field work were

developed to address these data gaps and to strengthen existing information. The emphasis of the field work will be on, a) refining the estimate of the total number of bears using the valley, b) estimating the population density of grizzly bears resident in the Khutzeymateen, and c) determining the relative importance of habitat units to grizzly bears, particularly a habitat unit's "patch" value. Patch value is the value of a habitat with consideration of its juxtaposition to other habitat units. Defining the patch value of a habitat is important for realistic evaluation of different land use options (*ibid*).

6.1 Objectives

1. To capture and radio collar 2-3 additional females and 3-4 males for a total sample of 6-7 females and 5-6 males.

2. To monitor the visitation rates of radio-collared versus uncollared animals to several remote cameras set up at strategic locations in the watershed.

3. To continue with weekly aerial telemetry locations and frequent ground locations of all radi0ocollared grizzly bears to identify habitat use and describe general bear behaviour.

4. To continue site investigations of radio-collared grizzly bear locations to evaluate the relative use of habitats by grizzly bears.

5. To evaluate ground and aerial telemetry locations for biases associated with site investigations of telemetry locations.

6. To locate and describe the physiographic characteristics of 1990/91 den sites.

7. To measure the vegetative and generative phenology of important grizzly bear plant foods in habitats representative of those occurring in the lower valley.

8. To locate and map bear trails that link the Khutzeymateen watershed with adjacent watersheds.

6.2 Field Work

6.2.1 Capture and Handling. — Grizzly bears will be trapped, immobilized, handled and fitted with radio collars following Hamilton and Nagy (1990). Trapping activities will be conducted over 2 weeks during late May and early June. Grizzly bears will be immobilized with Telazol (tiletamine hydrochloride and zolazepam hydrochloride). Trapping activities will be concentrated in areas not trapped intensively in 1990, including the mid and upper Kateen River, tributaries to the Kateen River, the upper Khutzeymateen River and tributaries to the lower Khutzeymateen and Carm Creek. Opportunistic trapping may occur along the lower Khutzeymateen River and Khutzeymateen estuary during late April and early May to adjust or replace the radio collars of 2 subadult males collared in 1990.

6.2.2 Remote Cameras. — Cameras will be set up at baited stations or along bear trails at up to eight locations in the lower watershed. Visits and visitation rates by radio-collared and uncollared animals will be monitored to provide more information on the numbers and possibly sex/age class composition of bears using the valley on a seasonal basis. Available time, money and accessibility will not allow us to use a systematic sampling design or stratified sampling design by habitat (Hovey pers. comm.).

6.2.3 Aerial and Ground Monitoring. — Aerial and ground monitoring will be conducted using previously described procedures (Hamilton and Nagy 1990, Nagy and MacHutchon 1991). Ground tracking will be conducted frequently along accessible portions of the Khutzeymateen and Kateen Rivers and their tributaries.

6.2.4 Habitat Use. — Monitoring of habitat use and activity site investigations will follow Hamilton (1987), Hamilton and Nagy (1990), and Nagy and MacHutchon (1991). Some of the site specific information collected in 1989 and 1990 will be eliminated to streamline the data collection and allow for more activity site investigations of radio-collared animals. An expansion of the trail system up Carm Creek provided greater access to lower Carm Creek in 1990 and different river conditions allowed for greater access to the lower Kateen River in 1990 than 1989. Monitoring of grizzly bear habitat use will increase further in these areas during 1991. In addition, some helicopter assistance will be used to monitor habitat use in areas not accessible by river boat or trail.

6.2.5 Telemetry Tests. — The assignment of an activity site to an individual grizzly bear was dependent on the assumption that ground and aerial telemetry locations had a reasonable level of accuracy. In most cases, we were confident in assigning a location to an individual animal, because an extensive search was done around a location, the specific location was verified using a variety of criteria (Nagy and MacHutchon 1991), and we were confident in the telemetry for most locations that were investigated. However, our telemetry techniques were not adequately tested using known location collars. To test our telemetry techniques in 1991, we will locate collars placed at various sites in the valley. Tests will be done during wet and dry conditions. Variability of the test fixes from the actual collar location will be documented.

6.2.6 Denning. — The den locations for 4 adult female and 2 subadult male grizzly bears radio-collared in 1990 were marked from the air in early February, 1991. These locations will be searched after the bears leave in the spring and the physiographic characteristics of each den will be recorded. If time permits, the 1989/90 den sites of GF34 and GF18 will be revisited to see if they have been used again. GF34 died in June, 1990, so reuse of her den might indicate whether her two yearlings survived through 1990.

6.2.7 Plant Phenology . — The phenology of important grizzly bear food plants will be monitored at nine plots established in 1990 along the lower Khutzeymateen River. The vegetative and generative stages (Luttmerding et al. 1990) of plant food species will be recorded weekly or bi-weekly. The species monitored will be sedges (*Carex* spp.), small-flowered bulrush (*Scirpus microcarpus*), devil's club (*Oplopanax horridus*), red elderberry (*Sambucus racemosa*), blueberry (*Vaccinium* spp.), stink currant (*Ribes bracteosum*), red-osier dogwood (*Cornus sericea*), skunk cabbage (*Lysichiton americanum*), salmonberry (*Rubus spectabilis*), and Pacific crab apple (*Malus fusca*). In addition, the proportion of stems with berries and the relative abundance of berries will be recorded for berry-producing species to determine seasonal patterns of berry availability.

6.2.8 Bear Trails. — In 1990, a well used bear trail was discovered that crosses the pass between Carm Creek and the Exchamsiks River. Attempts will be made to map other bear trails which link the Khutzeymateen with surrounding watersheds.

6.3 Field Schedule

Data on grizzly bear habitat use in the Khutzeymateen study area are insufficient for the early spring and summer. Therefore, field work will begin in early April to monitor the activity of radio-collared bears soon after they leave their dens. The intensive monitoring of grizzly bear activity will continue until late May when two weeks of helicopter-assisted trapping will begin. During the trapping period marked den locations will be visited. After trapping, intensive monitoring of all radio-collared bears will continue for the duration of the field season. Field activities will cease in the third week of October.

6.4 1990/91 Progress Report and Study Final Report

The 1990/91 progress report will be sent to the Research Advisory Committee in late summer, 1991, and completion is targeted for fall, 1991. Preliminary analysis of field data, to be included in the study final report, will commence in the field during September and October, 1991 and continue full time at the end of the field season. The targeted completion date for the final report on the Khutzeymateen Valley Grizzly Bear Study is March 31, 1992.

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APPENDICES

Appendix 1. Grizzly bear and black bear capture data, Khutzamateen watershed, spring 1990.

Bear	Day	Month	Sex	Age	Cap. Type [a]	Tooth Wear	Vulva Condition	Evidence of Nursing	Pelage Colour	Hind Length	Foot Width	Front Length (cm)	Foot Width (cm)	Baculum Length (cm)	Testes Length (cm)	Nipple Length (cm)
Grizzly Bears																
GF26[b]	2	6	F	14	CS	-	-	-	-	-	-	-	-	-	-	-
GF40	1	6	F	17	TS	heavy	swollen	lactate	brown	19.5	14.0	7.5	14.5	n/a	n/a	22
GF41	5	6	F	15	TS	mod.	normal	rubbed	brown	19.0	14.5	8.0	14.0	n/a	n/a	1.4
GF43	5	6	F	24	TS	heavy	slightly swollen	normal	brown	18.0	13.5	8.5	15.0	n/a	n/a	0.8
GM02	28	5	M	4	TS	mod.	n/a	n/a	light brown	19.0	14.0	7.5	15.0	15.0	7.5	n/a
GM22	26	5	M	4	TS	min.	n/a	n/a	light brown	20.0	14.0	7.0	14.0	13.0	-	n/a
GM36	27	5	M	3	CS	min.	n/a	n/a	brown	18.0	13.5	5.5	14.0	13.0	6.5	n/a
GM38	31	5	M	3	TS	mod.	n/a	n/a	med. brown	17.0	12.5	6.0	13.0	14.5	6.5	n/a
GM45[b]	5	6	M	11	CS	mod.	n/a	n/a	dark brown	22.0	15.0	10.0	18.0	-	-	n/a
GM80[b]	1	6	M	19	CS	heavy	n/a	n/a	dark brown	20.0	17.5	8.0	16.5	-	-	n/a
Black Bears																
BM03	27	5	M	ad	TS	mod.	n/a	n/a	black	14.0	11.5	6.0	12.0	15.0	9.0	n/a
BM12	4	6	M	ad	TS	mod.	n/a	n/a	black	14.5	10.5	6.0	11.5	16.0	8.0	n/a
BM35	24	5	M	9	CS	mod.	n/a	n/a	black	15.0	10.0	6.0	10.5	17.5	-	n/a
BM37	29	5	M	18	CS	heavy	n/a	n/a	black	14.0	9.5	5.0	11.0	17.5	7.0	n/a

[a] Capture Type: TS = trail set; CS = cubby set

[b] Because of difficulties with the immobilizations, some morphological measurements were not taken.

Appendix 1. Grizzly bear and black bear capture data, Khutzamateen watershed, spring 1990.

Bear	Body Weight (kg)	Zygo Width (cm)	Skull Length (cm)	Total Length (cm)	Tail Length (cm)	Shoulder Height (cm)	Neck Girth (cm)	Heart Girth (cm)	Abdominal Girth (cm)	Canine Length (cm)	Canine Width (cm)	Canine Span (cm)
Grizzly Bears												
GF26[b]	-	-	-	-	-	-	-	-	-	-	-	-
GF40	145.0	22.5	36.0	185.0	12.5	104.0	67.0	112.0	116.0	3.25	2.52	7.05
GF41	151.0	22.0	35.5	184.0	15.0	99.0	71.0	114.0	112.0	2.84	1.64	6.15
GF43	150.0	21.5	39.0	143.0	8.0	103.0	75.0	129.0	131.0	3.20	1.90	6.50
GM02	145.0	21.0	38.5	188.0	20.0	109.0	71.0	113.0	126.0	3.32	1.82	6.65
GM22	135.0	20.5	31.5	198.0	17.0	100.0	65.4	123.0	123.5	3.17	1.79	-
GM36	126.0	18.5	36.5	191.0	24.0	106.0	57.5	110.0	117.0	3.52	2.45	6.85
GM39	135.0	18.3	36.0	183.0	20.0	107.0	61.5	103.5	116.0	3.31	2.07	6.12
GM45[b]	-	-	42.0	-	17.5	-	-	-	-	-	-	-
GM80[b]	-	36.0	40.1	-	-	115.0	-	-	-	2.72	2.35	7.26
Black Bears												
BM09	100.0	19.5	25.5	157.0	8.0	89.0	71.0	95.5	104.0	2.85	1.68	-
BM12	110.0	19.0	29.0	163.0	5.0	90.0	66.0	102.0	98.0	2.98	1.75	5.86
BM35	73.0	17.5	25.0	160.0	9.0	89.0	51.0	87.0	101.0	2.80	1.80	-
BM37	65.0	19.0	29.5	158.0	9.0	87.0	45.0	82.0	95.0	2.40	1.85	5.98

[a] Capture Type: TS = trail set; CS = cubby set

[b] Because of difficulties with the immobilizations, some morphological measurements were not taken.

Appendix 2. Incidental bird observations in the Khutzeymateen study area by Julian week during 1990.

Bird Name	Incidental Observations (Julian Week) (April 22, 1990 - October 20, 1990)																								
	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Common Loon	•	•						•		•		•														
Western Grebe																										•
Great Blue Heron	•							•	•						•						•					
Trumpeter Swan				•																				•	•	•
Canada Goose	•	•	•	•			•		•					•	•				•							
Mallard	•	•	•		•										•	•		•								
Northern Pintail																					•					
Green-winged Teal		•	•	•														•			•					
Northern Shoveler				•																						
Ring-necked Duck																										•
Greater Scaup																										•
Barrow's Goldeneye	•	•	•																							
Bufflehead	•	•		•																	•					
Harlequin Duck	•	•	•	•	•		•												•		•					
White-winged Scoter																										•
Surf Scoter		•	•																							
Hooded Merganser			•																					•		
Common Merganser	•	•	•	•		•	•			•	•	•		•		•		•			•					
Red-breasted Merganser																		•								
Northern Goshawk																•										
Sharp-shinned Hawk																	•				•				•	
Red-tailed Hawk				•								•			•			•			•					
Golden Eagle	•																									
Bald Eagle	•	•					•					•			•						•					
Northern Harrier		•																								
Osprey																					•					
Peregrine Falcon													•													
Merlin		•	•													•										
Blue Grouse		•	•				•	•																		
Common Snipe				•													•									
Solitary Sandpiper																										
Spotted Sandpiper							•	•	•	•	•	•			•			•			•					
Greater Yellowlegs																		•			•					
Least Sandpiper																								•		
Glaucus-winged Gull																					•					
Herring Gull																					•					
California Gull	•	•		•																	•					

Appendix 2 (cont.).

Bird Name	Incidental Observations (Julian Week) (April 22, 1990 - October 20, 1990)																								
	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Mew Gull		•										•			•										
Ring-billed Gull																					•					
Bonaparte's Gull	•	•										•	•		•		•									
Marbled Murrelet	•		•		•				•		•	•	•		•											
Northern Pygmy Owl																					•					
Barred Owl																					•					
Black Swift								•																		
Vaux's Swift							•	•			•			•		•	•									
Rufous Hummingbird		•	•	•																						
Belted Kingfisher	•	•	•				•			•	•	•			•	•					•					
Northern Flicker																					•					
Red-breasted Sapsucker		•																			•					
Hairy Woodpecker		•	•	•			•														•					
Western Flycatcher												•														
Tree Swallow	•	•					•	•				•	•													
Barn Swallow		•		•			•	•				•	•													
Steller's Jay			•	•								•			•						•					
Common Raven		•	•	•			•														•					
Northwestern Crow	•	•	•	•			•	•	•								•				•					
Boreal Chickadee							•																			
Chestnut-backed Chickadee										•					•				•							
Red-breasted Nuthatch						•																				
Brown Creeper												•			•						•					
American Dipper		•								•	•			•	•						•					
Winter Wren	•	•	•																		•					
American Robin		•	•	•			•					•									•					
Swainsons Thrush							•					•														
Varied Thrush		•	•				•					•									•					
Hermit Thrush		•	•	•																						
Golden-crowned Kinglet		•										•	•	•	•						•					
Ruby-crowned Kinglet		•	•	•			•																			
Water Pipit	•	•		•																						
Yellow Warbler							•	•				•				•						•				
Yellow-rumped Warbler	•	•	•																							
Townsends Warbler															•				•							
Common Yellowthroat										•		•														
MacGilvary's Warbler										•	•															

Appendix 2 (cont.).

Bird Name	Incidental Observations (Julian Week) (April 22, 1990 - October 20, 1990)																							
	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Wilson's Warbler							•								•			•	•							
Red-winged Blackbird									•			•														
Rusty Blackbird		•	•																							
Grosbeak Evening					•																					
Pine Grosbeak											•															
Red Crossbill																					•					
Savannah Sparrow		•		•																						
Dark-eyed Junco												•			•						•					
Fox Sparrow											•	•														
Song Sparrow		•	•						•			•									•					

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WR-31 Wildlife habitat suitability of the Mackenzie Heritage Trail corridor. V. Hignett. May 1988. 16pp + 6 maps.

WR-32 Research priorities for furbearers in British Columbia. D. Blood. June 1988. 49pp.

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WR-34 A lynx management strategy for British Columbia. D.F. Hatler. July 1988. 121pp.

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